news, knowledge, advice

SCIENCE DIGEST

SEPTEMBER 1967 • 50 CENTS ICD

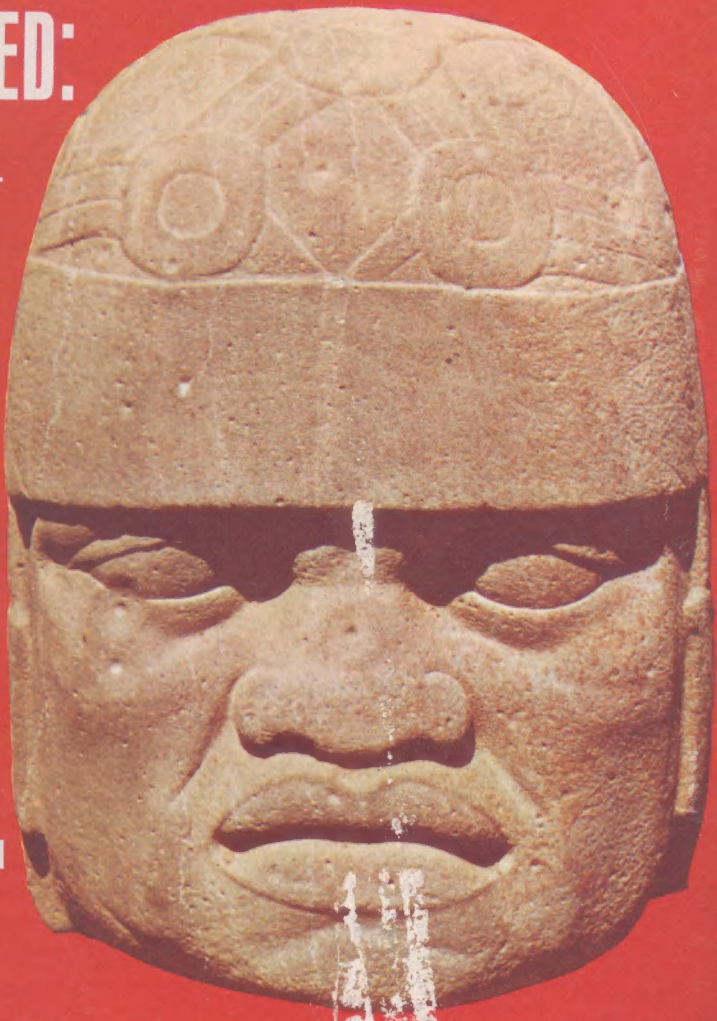
OLDEST AMERICANS UNEARTHED:

People of the jaguar

An MD explains: your chest pains may not be heart trouble.

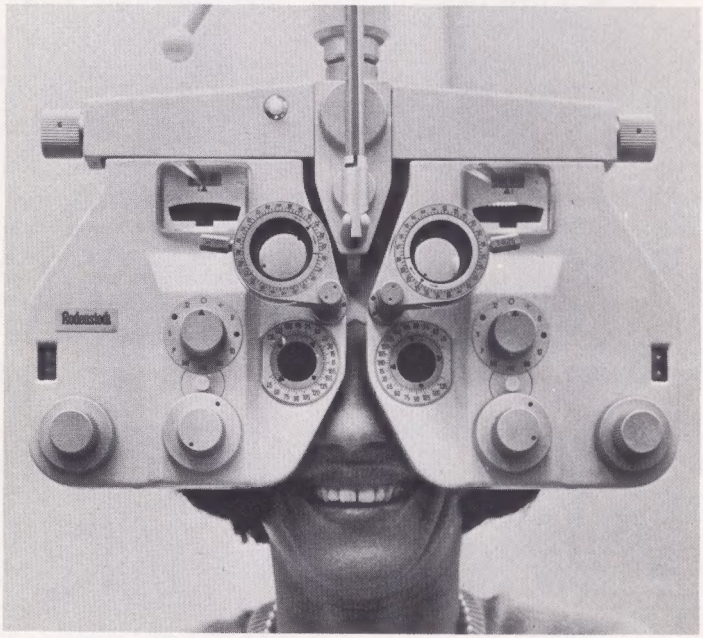
Margaret Mead: how "normal" is our neurotic behavior?

Fallout sizzle from underground A-tests



SPECIAL—

Isaac Asimov: after Apollo, a [illegible]ase.



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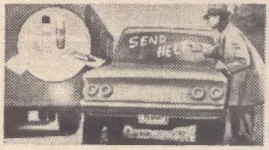

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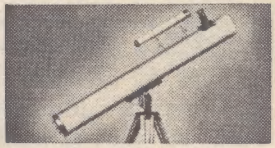

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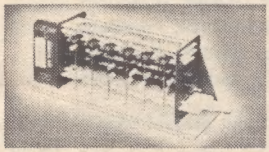

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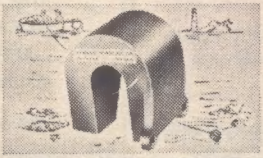

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ONE of the toughest things about putting together a magazine like *Science Digest* is deciding what to leave out. Take this month's cover story, for example. In just a few pages reporter Jeanne Reinert presents all the essential details of what we know about the fascinating and mysterious Olmecs. In order to do this she had to spend weeks digging deeply into the lore of the Indian civilizations of Middle America, and she reminded us of a story we must pass on. Many Indian

THIS MONTH

tribes were addicted to a game that resembled basketball. It was played on a stone court; the object was to get a hard rubber ball through a ring at the end of the court without the players using their hands. The ring was high and the hole in it was small, making the game very difficult. But when one of the teams did manage to score the audience began to run like mad. Why? Custom decreed that a member of the winning team had a right to claim the personal property of any spectator he could catch. A strange practice, but at least it cleared the house.

While we're about it, we'd like to apologize for an unintentional slight in our last issue. The striking pictures in the visual perception article were supplied by the University of Wisconsin.—*DC*

news, knowledge, advice

SCIENCE

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These gigantic heads, weighing 20 tons and more were first built and later buried by the mysterious Olmecs, first high civilization in the New World. Although these little known people may have been greater than the Aztecs or Mayas their secrets are only now being uncovered. A report on recent discoveries begins on page 6.

Photo by Dr. Michael Coe

DIGEST

SEPTEMBER • 1967 Vol. 62, No. 3

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NEWS IN BRIEF

Bulletins at press time

NEW FILTER. A tasteless, harmless substance that is supposed to make smoking "materially safer" has been developed by a chemist whose parents died of cancer. Working independently Robert L. Strickman discovered the polymeric substance and gave ownership rights to Columbia University. Strickman hoped that profits from his invention would be invested in education and cancer research.

NEW WARNING. Health, Education and Welfare Secretary John W. Gardner wants cigarette manufacturers to give smokers even stronger warnings about the hazards of their products. Gardner believes that the case against cigarettes has been strengthened since release of the Surgeon General's report on smoking and health in 1964.

ANOTHER DRUG DANGER. A new hallucinogenic drug called STP that has been spreading among drug takers on the West Coast has been found to be related to mescaline, a drug that has been used for centuries by American Indians to induce trances and states of religious ecstasy.

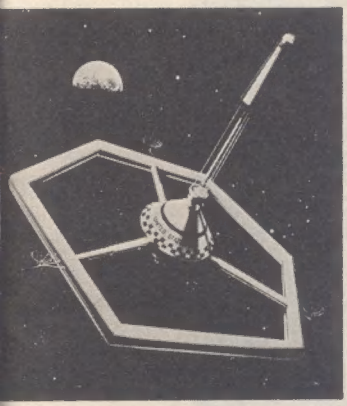
PLASTIC TOOTH COATING. An 86 percent reduction in tooth decay is the result when a clear plastic coating is applied to the biting surface of the teeth twice a year. The technique is still experimental but findings of a two year study conducted in Rochester, N.Y. were hopeful.

"CANCER VIRUS". A virus believed to be related to the cause of some forms of cancer, "has been caught in the act of infecting, reproducing, and killing certain human cells," according to Dr. James T. Grace Jr., director of Roswell Park Memorial Institute, a cancer research center.

IS IT ATLANTIS? Archaeologists have discovered a city buried by a volcanic eruption in about 1500 B. C. They believe it may have been the spark for the legend of Atlantis. A full report on the "lost continent" will appear in the next issue.

Is yours the special kind of mind that has to know...

. . . what happened to the master builders who created great civilizations, then vanished forever without trace, leaving elaborate cities and cultures crumbling in the jungles.



. . . what it will take in equipment, knowledge and human capability to send men on deep space voyages to the outer planets and beyond —and when we'll be able to do it.

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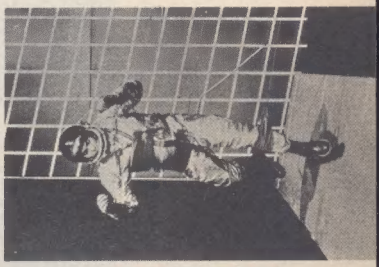

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Secrets of the people of the jaguar

In 1939 the first of the gigantic stone heads was uncovered in Mexico. It was a hint of revelations to come about a strange people who had flourished and been forgotten.

by Jeanne Reinert

THIS spring, in a tangled growth in southeast Mexico, 17 men strained and sweated to lift up a life-sized stone statue, buried 3,000 years ago.

The find was a triumph of inductive reasoning. For Dr. Michael Coe of Yale University, the unearthing of the statue and many other finds was an archaeologist's dream-come-true. And he is that archaeologist. The process started with graphs and charts of the San Lorenzo plateau. Small crosses marked each artifact site from the first

archaeological season and the current, 1967, season. Workmen had just uncovered a stone stela (marker). Dr. Coe noted a north-south orientation to several finds. Could these statues have been buried systematically? He ordered the workmen to begin to dig several feet to the north of the stone stela's location. The ground was unmarked, overgrown. Yet, after digging three or four feet, workmen began to uncover the life-sized figure, now headless. Dr. Coe, relating their astonishment, laughed, "They said I have eyes that can see through the ground." The statue had been made, and buried by a forgotten people called the Olmecs.

Library shelves are lined with books on the past—Egypt, Greece, Rome. From the American continent come books on the Eskimo, Inca, Maya and Aztec. But there are hardly any references to the first great civilization in the Americas, the Olmecs. Yet, the Olmec world was the mother culture for all the fabled Indian empires that rose and fell in Mexico and Mesoamerica. Little has been written about the Olmecs because archaeologists are just beginning to discover and to sort out the jumble of artifacts.

Dr. Coe is exuberant about the Olmecs. His eyes light up when he repeats, "It's luck, really luck." Spread about his third-floor, walkup office in an old, converted house on the Yale campus are numerous mementoes from the excavations. He is a man of medium build, with dark, wavy hair and a love for his work. Nothing could make him happier than the fact that, "There are probably a thousand statues at San Lorenzo. I'll never have time to dig them all up."

His Olmec finds this year are spectacular. They include man-made mounds, stelae, a giant basalt head (see cover), a lifesized figure in a cape, a stone jaguar, an archaic Olmec statue with features scratched rather than fully formed, a "fantastic spider", the headless statue and yards of San Lorenzo waterworks. But the key to his finds is discerning a systematic pattern.

The pattern for burying the mon-

Among Dr. Michael Coe's finds for the year was a "fantastic spider". Dr. Coe credits his success in finding Olmec artifacts to having discovered the pattern of burial.

The headless statue was apparently deliberately broken before being buried. Shoulder sockets of life-size figure show where movable arms must have been attached.

uments was determined long ago when dissident Olmecs overthrew their rulers. The rebels then set about destroying the art works of the old rulers. Why they did this is a mystery. As Dr. Coe points out, it is a difficult task to destroy a 10 or 20-ton basalt monument. The rebels apparently took the monuments to a special location (still unknown) deliberately to mutilate them. He thinks they used two methods: One was pockmarking the statues with a two-pronged instrument (see below left eye of cover monument). The second method was to hoist one monument on a tripod, then drop it on another. This would at least knock off a head or mar the face. Thousands of stone monuments were so destroyed. Each was then moved to a ceremonial burial ground. There the Olmecs built a red gravel floor and placed the marred monuments on the north-south axis in straight rows. Then, basket by basket, they brought a massive fill to the burial grounds. Clay, earth, boulders, consolidated volcanic ash, bits of broken pottery were used for the burials. It took an enormous amount of organized labor to destroy and bury each monument. When the huge stone markers were covered, small mounds were built on top. These finger-like ridges still extend from the south of the San Lorenzo plateau, as much as 10 feet above the plateau. Until Dr. Coe realized the mounds were man-made, they were considered a natural part of the terrain. He thinks the mounds might have had houses or temples built on top of them.

Dr. Coe is confident that there was no invasion from neighbors or barbaric tribes because the pottery and other artifacts from the following periods are all Olmec. This is a new finding, as it was formerly believed the culture was overrun by other Indians.

Who were these people, the Olmecs? Where did they come from? When did they flourish?

The name, Olmec, means "Rubber People". No one has any idea what the people called themselves or what language they spoke.

The first Olmec artifact to attract archaeologists turned up in a plowed field in 1902 not far from the Bay of Campeche in the Gulf

of Mexico. Sculpted in pale green jadeite was a beautifully-carved fat, bald-headed Indian priest about eight inches high. Undecipherable glyphs were incised on its stomach. Also on its stomach was a Mayan date. The date corresponded to 98 B.C., well before any known Maya civilization and in the wrong area of Mexico for Maya.

The long-count calendar, attributed at that time to the Maya, is a more accurate calendar than the one we use today. It begins, for unknown reasons, in the year 3113 B.C. Closely correlated to astronomical observations, it can be read precisely for any day and year in the intermediate period and transcribed into a date in terms of our calendar. It is a masterpiece of mathematical and astronomical knowledge, and it was the Olmecs, not the Maya who developed it.

The Indian statuette was the first clue that some civilization pre-dated the Maya and invented this calendar. Curious about this find, Mathew Stirling, an American archaeologist, lead the first of nine expeditions into the Mexican Gulf coast. This area, later dubbed the "Olmec heartland", is 125 miles long and about 50 miles wide. At an island site, La Venta, Stirling found, in 1939, five gigantic basalt heads. (See photo, p. 6) Free-standing, these heads are five to nine feet high and weigh up to 20 and 30 tons each. All wore close-fitting caps that look much like today's football helmet. He also found great caches of jade, more prized than gold by the Olmecs. There were also altars and pyramids. La Venta, an island in a swampy and mysterious area, is perfect for a ceremonial site. Olmec people probably travelled to it to give offerings of jade and other treasures to the gods.

San Lorenzo, Dr. Coe's excavation site, may have flourished at the same time, between 1200 and 800 B.C. or possibly later. San Lorenzo, in the heart of an agricultural paradise, was probably the civil center and a population center. No caches of treasure have been uncovered, but the wealth of stone monuments suggests that there were probably thousands and thousands of wood carvings, textiles, maybe even painted language books, all since devoured by the sweltering climate that dumps 120 inches of rain annually on the area. That climate is perfect for growing corn, the staff of the Olmec diet.

One of the pleasantries of life at San Lorenzo 3,000 years ago was an elaborate system of waterworks. Dr. Coe has uncovered several hundred yards and expects there will be miles of them. The Olmecs built six-sided artificial ponds or lagoons to supply water for the city. They then built irrigation networks from imported basalt blocks. The basalt was brought from at least 80 miles away, probably on rafts. They chopped out troughs and made tightly-fitted basalt covers. Even today, when the lagoons are filled during the rainy season, water runs in the network although it has been unused for 2,600 years.

San Lorenzo was deserted about 400 B.C. Then about 1,800 years later, other people settled there, leaving pottery fragments that can be dated by carbon-14 methods.

The legends of the later Aztecs give the only hint of the vast Olmec culture in a group of legends of a golden land of long ago. The legendary land was called "Tamoanchan." This name, however, is not Aztec, but is now known to be an archaic Maya word. There are two translations. One is the "Land of Rain and Mist", a perfect description of the Olmec heartland along the Mexican Gulf coast. The other meaning is "Bird-Serpent", a symbol that recurs in Olmec art. The myth says this was the land where everything began.

Dr. Coe believes that the Olmecs

A common feature in Olmec art are the grotesque sexless creatures that Dr. Coe calls "children of the jaguar". These figures could have been inspired by abnormal children whom the Olmecs worshipped. The Olmecs may have believed such children were part jaguar, part human. Standing figure left holds child with pronounced jaguar features. Seated figure above is one of a group of hollow clay "child" figures recently discovered in Mexico. Says Dr. Coe, "Their expressions and slanting eyes give a strong impression of some condition like Mongolism. Their jaguar ancestry shows only in the down-drawn corners of the mouth."

were the earliest Maya and then died out, persisting only in this legend which contained the memory of a rainy and misty land. The whole Olmec world was in ruins by the time of the Aztecs.

The Olmecs were gifted both as artists and artisans. Their sculpture is unsurpassed. They worked not only in the imported basalt, but also in jade. Without metal tools, they designed massive, three-dimensional, free-standing figures of many types. "We can say they were the inventors of sculpture and their monuments represent the first appearance of this art. We consider them among the most extraordinary sculptors that Mesoamerica ever produced," judged Ignacio Bernal, a Mexican archaeologist and authority.

Baby-nosed statues

Consider the great basalt heads, now numbering about 20. They all have similiarities such as the flat, rather infantile noses. All are plump. Archaeologists have speculated that they may represent war lords. The one head that still has the original finish was smoothed to a satin luster, the stone looks like skin texture. And apparently the heads were painted as one still shows a white slip painted purple.

There are also figurines, plates, bowls, cooking utensils, beads, ear plugs and axes made of clay, jade, magnetite and loadstone.

The most common motif of the spectacular art works is the jaguar. This powerful cat is unusual in that it loves water, is often found near rivers and, swims well. It was no doubt worshipped as a god by the Olmecs. The evidence suggests that the Olmecs probably believed the rain-gods descended from a union of a jaguar and a woman. This is the subject of one Olmec monument. Further impressive evidence for this theory is the abundance of figures with part human, part feline features. Olmec art runs a gamut from pure jaguar features to statues with barely perceptible jaguar mouths. A common motif is the stout, sexless, nude figure, frequently shown in postures identical to those of a young baby. Mouths droop down at the corners, reminiscent of a snarling jaguar. Many of the figures have a slight cleft centered above their foreheads. Often maize or other grain plants are depicted sprouting from the cleft, probably symbols of agricultural fertility.

Most Olmec jaguar figures have a curious look suggesting Mongoloidism or cretinism. Perhaps from time to time a congenital defect showed up in an abnormal baby. This, says Dr. Coe, may have reinforced the Olmec belief that there could be gods that were part jaguar, part human child. There are deformities in which the soft spot in the skull never closes. The Olmecs may have believed this was a sign from the gods.

Perhaps the Olmecs worshipped such a child and carried it about reverently. They may have be-

Three Olmec paintings found this spring are the oldest in the New World, yet they retain their vivid colors.

lieved it a sign from the rain gods. In later Indian cultures, and possibly originating in the Olmec culture, infants were sacrificed to the rain gods. The people believed that the more the baby cried and tears streamed down its face, the more rain would be sure to fall.

Trade was well-integrated into the Olmec life. There were probably extensive water routes between Olmecs and surrounding peoples. The Olmecs may have set the pattern for the later spread of culture throughout Mesoamerica.

Some archaeologists think the Olmecs arose in Guerrero, now famous for its resort city of Acapulco. There are ceremonial sites in this state and probably jade sources. Two unique Olmec finds have been found in Guerrero. One is a wooden mask, incrusted with jade, miraculously preserved in excellent condition. The other find was reported this spring by Dr. Carlo T. E. Gay, an amateur pre-Columbian expert. It consists of three paintings and three drawings, found in a cave, all in the distinctive Olmec style. The best painting is a life-sized figure of a bearded man, dressed in a yellow and red striped shift and carrying a pelt. Another figure, possibly is a spirit of the earth. The paintings and drawings are in good condition with only a few areas obscured by calcite. Although they are the oldest paintings ever found in the New World. The colors are vivid reds, yellows and black.

The Olmecs loved color. They decorated their bodies with stripes and designs. Among the artifacts are dozens and dozens of rollers to spread the colors evenly over the large portions of their bodies.

Temple walls, floors and sacred grounds were splashed with color. For example, one abstract design of a jaguar mask was found 25 feet below the topsoil of La Venta. The ancient Olmecs laid green polished paving blocks in a yellow clay border, then inserted blue clay for the eyes, nose and mouth.

Nothing remains of the houses or structures such as temples. There is a single bottle from Tlatilco which is shaped like a house or temple. The structure is probably of thatch with pole sides and covered with adobe, much like Mexican construction of today. This bottle is the only glimpse of how Olmec structures may have appeared.

Nothing is known of the family makeup or political complexion of the Olmecs. There are some undeciphered glyphs (picture language symbols) that may some day provide a bit of history. Or perhaps still unexcavated ruins will answer the many questions surrounding these mysterious and little-understood Olmecs who created the first great civilization in north or South America.

Dr. Robert C. Pendleton of the University of Utah Department of Molecular and Genetic Biology sets up equipment in lead chamber for radiation studies at University.

Underground A-tests may be making us radioactive

An outspoken Utah scientist issues a grim warning about the hidden dangers of Amercia's current nuclear test program.

by Nelson Wadsworth

SOMETIME during fiscal 1969 the Atomic Energy Commission is planning to detonate a 100-kiloton nuclear blast in sparsely-populated southwest Idaho, not far from the little desert town of Bruneau near the Oregon and Nevada borders.

The underground explosion—known as "Project Schooner"—will be part of the AEC's "Plowshare Program," aimed at exploring the peacetime use of such shots for canal and harbor excavations.

Because the isolated test site is in a rocky, arid wasteland of the West, the "Schooner" blast sounds

as harmless as a firecracker in Central Park. Nothing could be farther from the truth, says an outspoken scientist from the University of Utah in Salt Lake City, who has spent the last six years studying the accumulation of radioactive fallout from Nevada testing on plants, and in animals and man in Utah.

And furthermore, adds Dr. Robert C. Pendleton, associate professor of molecular and genetic biology and director of the university's department of radiological health, if the AEC triggers the Idaho blast, it will be making human guinea pigs out of thousands of people who live "downwind" beneath the radioactive fallout track.

"The testing of nuclear weapons for the nation's defense is one thing," Dr. Pendleton says, "and for this we should be willing to pay the biological price. But when we turn loose highly dangerous radioactive materials merely for engineering purposes, we have entered onto entirely different moral grounds."

Milk supply contaminated

Dr. Pendleton is afraid there will be a repeat of dirty "Plowshare" blasts such as the 100-kiloton "Sedan" shot on July 6, 1962 that showered Utah with vast quantities of radioactive nuclides, temporarily contaminating a portion of the State's milk supply. The effects of "Sedan" and the overlapping fallout of the "Small Boy" weapons blast on July 14—are still being felt and will be for many years to come. The "Sedan" shot, a cratering blast, sent what Dr. Pendleton calls a very dirty radioactive cloud over Utah.

The cratering blasts of the AEC are designed to lift many tons of overburden and leave behind a huge excavation. Actually, they are nothing but a gigantic earth-moving device. Proponents argue that a large proportion (up to 95 percent) of the nuclides fall back into the crater or are deposited very close to the blast site. However, as Dr. Pendleton points out, a disproportionate amount of radioactive strontium, cesium and iodine come out of the detonation as gases and are carried away in a radioactive cloud, much of it later to fall back to the earth far from the blast site.

These isotopes filter to the ground, often hurried down by rainfall or trapped by natural mountain barriers in their path. The high Uinta Mountains in northern Utah receive a heavy deposition because they lie directly in the path of many of the fallout trajectories from Nevada, and in some places have up to 40 inches of annual rainfall.

The nuclides settle on vegetation, especially in the wet meadowlands where dairy cattle graze. Following the 1962 shots, the highest readings were recorded in the Salt Lake and Cache Valleys and in northeastern Utah's Uinta Basin, all noted for their dairy herds. Radioactive iodine (I-131), cesium-137 and strontium-90 are taken into the bodies of plant-eating animals. The relatively short-lived iodine—which decays to half its strength in eight

"When we turn loose radioactive materials for engineering studies we are on different moral grounds"

days—quickly finds its way into man's food web through his milk supplies. And once in the human body, it settles in the thyroid gland which has an affinity for iodine. Through the same food chain, strontium-90 accumulates in bone, and cesium-137 deposits in muscle and other tissues. The end result could be thyroid tumors, bone cancers, thyroid cancers, leukemias, or undesirable genetic mutations, resulting in a higher incidence of miscarriages and abnormal children.

"The Idaho test should be considered from the standpoint of human experimentation because we don't fully know what is going to happen," Dr. Pendleton says. "No-one can predict how many human defects will be caused by such a fallout cloud. The release of hundreds of billions of tiny radioactive particles into the atmosphere could result in an increase in the number of lung and lymph-node neoplasms in the people who breath the aerosol while it passes over their houses.

"We have found radioactive dust on the farm machinery used to harvest the crops following fallout from Nevada, and almost all the lungs of deer taken in this State showed detectable levels of plutonium, a very dangerous nuclide. Farmers exposed to dust while harvesting crops in 1962 showed internal contamination by isotopes not normally metabolized, and not detected in city residents."

Should the AEC be required to meet the same standards regarding human experimentation as are required of other researchers, Dr. Pendleton asks?

"Surely each person to be showered with radioactive dust from engineering tests should be fully informed of this possible hazard, and should be given a chance to decide whether the risk is justified."

He adds, the damage may not show up for years after the initial exposure—or it may combine with other factors to cause the defects. A rash of recent lung cancer deaths in uranium miners seems to prove this delayed reaction theory. Miners are still dying from breathing the dusts of the poorly-ventilated mines during the early uranium boom of the 1950's and early 1960's. And some of these miners showed no symptoms until 6 months before their deaths.

Dr. Pendleton's words are not based on theories but on facts painstakingly gathered in six years of selective sampling. By monitoring the accumulation of radioactive fallout in Utah farms and mountains, he has uncovered some startling and revealing facts that would indicate the AEC's cratering blasts should be carefully reviewed.

Outside of the Marshall islands in the Pacific Ocean, and possibly some parts of Siberia, Utah has

been showered with more atomic fallout than any other populated region in the world. Because of the State's close proximity to the Nevada test site, prevailing winds often carried the fallout trajectory over a wide swath of the state. And although there is a test-ban treaty, "venting" of underground nuclear tests can still cause contamination. The last major venting occurred in April, 1966.

Radiation rainfall samples

Though Dr. Pendleton's research did not get under way until 1961, many scientists are reasonably sure large segments of the population of Utah were repeatedly exposed to undesirable levels of radiation in the early days of atomic testing.

Some proponents of the "Plowshare" tests may argue that modern nuclear devices have a low fission yield and are relatively "safe."

"I have no reason to disbelieve this, but on the other hand, I have absolutely no evidence to support it either," says Dr. Pendleton. "We have nothing in which to make a valid judgment, so we can only go on what has happened in the past."

To the Utah scientist and his colleagues, as well as other researchers across the U.S., finding the effects of fallout has meant meticulous scientific searches. For the Utah team it has meant endless days of collecting animals, sampling soils and vegetation and recording thousands upon thousands of readings both in the field and in the lab. It has meant a thorough milk sampling program, and contact with farmers in all parts of the state. Each fall it has meant an annual pack trip into the High Uinta Mountains. To Dr. Pendleton, the Uintas have proven to be "a most perfect outdoor laboratory" for his studies on the possible effects of radioactivity on the ecology of an uninhabited wilderness area.

Field studies, conducted from tent camps in the mountains, show an even more rapid accumulation of radioactivity in wildlife than in man, especially in predators like the cougar which have relatively simple food chains.

The Uinta Mountain deer, Dr. Pendleton found, are the most radioactive of their species in the state. This is because they depend for food on the fallout-contaminated vegetation of the damp mountain slopes. Readings as high as 3,000 picocuries of cesium-137 per kilogram of flesh were found in these animals. But the cougars that depend for food on the flesh of deer show a three-fold increase per kilogram of flesh over their principle food. This three-fold trophic level increase has been established as a rule of thumb in simple food chains —from prey to predator, cesium-137 content per kilogram of soft tissue increases three times.

Utah researchers found a similar transfer of radioactivity in aquatic life in the high mountain lakes. Large trout caught in the Uintas showed higher levels of cesium-137 than fish of any kind taken in other

In the event of nuclear war the unforeseen effects of fallout on the ecologies of the world may be disastrous.

parts of Utah. The larger the fish the higher the reading. This, says Dr. Pendleton, is because big fish are at the end of the food chain. Being cannabalistic they feed on smaller fish. The small ones in turn accumulated the cesium-137 when they fed on insects and other natural foods in the lakes.

If a man subsisted primarily on fish caught in the high Uintas, he too would show a three-fold increase in radioactivity over the level in his food. For this same reason, the Alaskan Eskimo and the Swedish Lapp, as reported by other researchers, are among the "hottest" humans on the face of the earth. Though they are not in close proximity to atomic testing, their food chains are relatively simple. Radioactivity builds up quickly. Here's how it works: Isotopes from atomic testing settle on plants in the arctic tundra, particularly collecting in the hardy, long-lived lichen, upon which reindeer and caribou feed. After eating the plants, radioactivity in the animals become as much as three times higher. The Eskimo who eats the caribou meat increases his own body burden even more, depending on how much of his diet is contaminated meat.

In the event of nuclear war, says Dr. Pendleton, the unforseen effects of fallout on the ecologies of the world may be as disastrous as in the blast areas themselves.

Dr. Pendleton admits science has only scratched the surface in sleuthing the effects of radioactivity on the biosphere. But he says the fact that there are so many unknowns makes the Idaho blast and others like it "ecologically indefensible." Though the "Schooner" shot will be located in a desert wasteland, it is surrounded on three sides by productive, irrigated farmlands.

To the west lies Oregon. To the east lies the lush pasturelands of Idaho's Snake River Valley and northern Utah's Cache Valley. And to the north lies Boise, Idaho.

Only if the fallout goes due south into Nevada would it miss concentrations of human habitation, and weather conditions prevailing in that vicinity make this unlikely.

"You can hardly expect an absence of doubt under the conditions prevailing—that is, research coming only from a group that is funded by the same agency that proposes to do the test," he said.

"It is very difficult for me to visualize the stand of the United States Government in this. While we are making such strong efforts all over the nation to clear up the air and remove pollution, we have an agency proposing to release massive quantities of radioactive air pollution to drift down over the inhabitants of the country without even asking a by-your-leave as to whether they may do so."

NEW FOR PEOPLE

▲

Tamper-proof pill vials promise to reduce the over 5,000 accidental poisonings annually to U. S. pre-school children. Introduced by Chancellor Industries, Inc., the vial is opened by depressing cover, lifting it off, then unscrewing bottom portion of container. Pre-schoolers are not strong enough to perform this feat.

▲

Cardiac pacemakers, surgically implanted, "pace" the hearts of some 15,000 American heart patients. The battery-powered instrument stimulates or "paces" weakened or damaged heart muscles. General Electric's new Pacemaker—smallest available in this country—is shown next to the life-size model of a human heart.

Acoustic beacon developed by the Burnett Electronics Laboratory searches out submerged objects. Scuba diver can carry unit at left which directs him to sought-after object. Unit at right is used by surface craft to locate items by closing in on sound from the acoustic beacon. ▶

◀ **Television education** comes to American high schools via closed-circuit system of Sylvania Electric Products, Inc. System permits any location in school to serve as studio for "live" programming. Equipment can be removed from school to tape record outside events and playback later. Ski student views replay of her practice run down mountain ski course.

PSYCHOLOGY

Art teacher William Nicol has collected over 1,000 drawings from Aborigine children, like the two reproduced below. The paintings were done with the children using European utensils, color crayons, felt pens and paper, for the first time. Mr. Nicol hopes eventually to have a cross-section of the youngsters' works exhibited in Australia's art galleries and schools.

Primitive—primitive art

THE uninhibited drawings of children can be an accurate portrayal of a society and its customs. On this premise, a Melbourne art teacher, William Nicol, returned to central Australia—the last stronghold of the country's 100,000 Aborigines—to collect and record the tribal art of their children before it is erased by the encroachments of European culture.

Large numbers of Aborigines are now living on government and mission settlements, going to European schools and adapting to European ways. On a previous trip to the remote Northern Territory and central Australia, however, Nicol discovered that the ancient culture of the Aborigine tribes has been preserved and is reflected in the youngsters' art.

Nicol, his wife and another couple organized a second expedition with the help of a $3000 grant from the Australian Institute of Aboriginal Studies. They took with them a supply of crayons, paper and felt pens for the young artists to use. Though accustomed to sketching in the sand with their fingers or using twigs for more sophisticated efforts, the Aborigine children readily took to the new implements.

"They have a parental tradition of mother and father using the sand to illustrate stories, to make maps, to tell of the day's happenings and to teach the youngsters how to make tracks," explained Nicol. He also notes that, though illiterate by European standards, the Aborigines knew more of their origins and history than the average reader of the daily newspaper in cities did about his. Traditions are kept alive verbally since they have no written language. Each generation transmits the tribe's history to the next by songs, chants, stories and rituals. A rudimentary democratic system gave form to the unsettled existence of a nomadic people.

The family group consists of husband, wife or wives and children, either natural or adopted. Each has his work to do in the daily foraging for food that their harsh life demands. Father hunts, mother picks berries and seeds and the children, as soon as they can walk, are taught to track small animals for food.

Like all good artists, these children express what they know best; and set these daily activities into accurate representations of landscape and climate.

"Their use of color, especially greens, blues and purples, not seen in tribal color range of black and white ochres, is exciting," says Nicol. "They are natural colorists with . . . keen observation and a powerful sense of draughtmanship."

The style of some regions has been influenced by famous Aborigine artists such as Albert Namatjira. But the skill with which these young people depict their country and the control which they exert over their media can't be chalked off to imitation.

Science Month

How birds get home

A father-son team is trying to determine the navigational ability of birds. Working with a computer on the knotty problem are Dr. Helmut E. Adler, an experimental psychologist at Yeshiva University and a research fellow in the department of animal behavior at the American Museum of Natural History, and his son, Barry, a psychology student at Long Island University.

Scientists know that birds fly to far-off goals on journeys covering several days and even weeks. A Pacific albatross was ferried by plane from Midway Island to Luzon in the Philippines. Released, it returned to its nesting place 32 days later, after covering 4,120 miles.

The Adlers in studying the biological mystery of bird navigation are using an IBM 7094/7040 direct-coupled system at Yale University Computer Center, New Haven, Connecticut. Young Adler developed a mathematical model of bird migration and wrote a computer program based on the model to simulate the flight path of birds.

The flyway created within the computer revealed that birds reach their goals by a trial and error navigational method. Given time to compensate for directional errors, birds can reach destinations thousands of miles away.

Microbiologist Peter Madri holds a redbeard sponge that relishes water-polluting bacteria. One orange-colored redbeard may absorb 750,000 water bacteria in six days. Scientists plan to plant the sponges along the U.S. eastern seaboard.

Soaking up pollution

Scientists at Fairchild Hiller's Republic Aviation Division of Life Sciences Department have found that the orange-colored, redbeard sponge—technically known as *Microcionia prolifera*—relish harmful, sea water-polluting bacteria.

The marine animal, found along America's seacoast from Cape Cod to Cape Hatteras, literally soaks up *Escherichia coli*, a major source of bacterial water pollution. Sea water does remove some pollutants but

Many private planes are damaged and some fatalities result from hailstones pelting the craft. FAA warns pilots to stay grounded during thunderstorms that breed hail.

the redbeard sponge's ingestion capacity of *Escherichia coli* is over 30 times greater than the bacteria-killing effect of sea water.

Peter Madri, a Republic microbiologist, conducted a study with fellow scientists by placing an equal amount of concentrated *Escherichia coli* in a tank containing the sponges and in a control tank of sea water.

Water tested in the control tank on the sixth day had approximately one million bacterial organisms per cubic centimeter. Only 5,000 bacterial organisms per cubic centimeter were in the tank with the sponges. A sample sponge had absorbed 750,000 bacteria but had less than 100 of them when put in the tank.

Stones from clouds

Hailstones can damage an aircraft sufficiently to cause disastrous results. It is known that thunderstorms produce hail. It is not known with precision which thunderstorms breed hail or where the hail will fall.

Hailstones have showered planes 15 miles away from a thunderstorm. But aircraft most frequently run into hail at altitudes between 10,000 and 15,000 feet, although one-inch hailstones have pelted planes at 45,000 feet and two-inch stones at 35,000 feet.

Weather Bureau radar can determine with good accuracy storm intensity, movement, height and rate of development. However, the Federal Aviation Agency warns that the safest way to escape hail damage is to keep out of and away from thunderstorms. The safest rule is not to fly in weather conditions that breed thunderstorms.

Aust. News and Information Service

Specimens of lungfish being lugged to park in Australia. Unusual fish has rudimentary lungs but must surface occasionally to survive. Species is extremely rare.

New look for the navy

A hydrofoil gunboat that skims above the water in excess of 40 knots an hour is slated to join the U. S. Navy later this year if tests of the revolutionary *Tucumcari* prove satisfactory. The 60-ton aluminum gunboat with a 20-foot beam and 71-feet long is driven by a 3,100 horsepower Bristol Siddeley Proteus gas turbine engine and a Byron Jackson pump.

The propellerless *Tucumcari* rides on foils which lift the hull into the air, greatly reducing water resistance to the craft's forward motion. The gas turbine-driven centrifugal pump draws water in through two ports in the base of the aft foil hollow struts, and ejects it under the stern of the gunboat.

The pump forces water out of dual exit water ports at approximately 27,000 gallons a minute, using a water propulsion principle to drive the boat similar to the air thrust of an airliner's jet engine.

The *Tucumcari*, designed and built by Boeing, is equipped with a second water jet propulsion system powered by a diesel engine. The second system is used for cruising on the boat's hull or in case the larger engine is damaged or has technical difficulties.

Armed with a forward 40mm gun, an aft 81mm mortar and twin 50-caliber machine guns, at each side of the bridge, the *Tucumcari* promises to be a formidable foe.

Lungfish park

A lungfish park for residents of Bundaberg, Queensland, Australia, became a reality when two specimens were caught in a nearby river

and released into an enclosed pool in a fauna reserve at the city's edge.

In evolutionary zoology, lungfish are regarded as a transitional group between true fish and amphibians. Fossilized specimens appear in rock dating 400 million years ago. At one time lungfish, also called dipnoids, were found in many parts of the world but slowly they disappeared.

Today there are three living species: the *Epiceratodus* of Australia; the Central African *Protopterus*, and the *Lepidosiren* of South America. They have rudimentary lungs and come to the surface to breathe intermittantly.

Lungfish grow slowly. One six-footer is believed to be 100 years old. Usual length is about four feet and they weigh around 40 pounds.

Lungfish feed on plants and animals found in the water, and can live in shallow, stagnant pools where other fish die. They are dark green on the dorsal surface and vividily red in the ventral.

Why do elephants migrate hundreds of miles to the north? The question is the subject of research by conservationists in South Africa's big Kruger National Park. Rangers are knocking out migrant elephants by shooting them with drug projectiles and marking them with paint. If the cause of the elephants' migration can be learned, roaming elephants may be stopped and great forest areas saved from ruin by trampling.

Next household word—FLUIDICS

by Morton J. Schultz

A United States Destroyer recently backed from its berth into a ship-cluttered harbor and paused.

Suddenly, to the bug-eyed astonishment of onlookers, it pivoted 180° on its own axis as easily as a baton spins on the fingertips of an expert twirler. In less than three minutes, it was heading for open sea.

Mariners watching the operation had reason to do double-takes. They knew that a DD-class ship of the line normally needed plenty of leeway and at least 10 minutes to make a 90° turn. Ships, like cars, must move forward to turn.

The destroyer itself is of little consequence. But the device deep in its bowels which permitted this nautical miracle—called a fluidic amplifier—has scientists and engineers excited.

If you haven't heard of fluidics, you will. It promises a whole new line of less expensive, more reliable and maintenance-free airconditioners, dishwashers, clothes washers, refrigerators—even automobiles.

What is fluidics? And how does it work? The industry is growing so rapidly, with new theories awaiting trial, even the experts cannot

A miniaturized amplifier for fluidic control is comparable in size to electronic amplifier. Predicted smaller units promise maintenance-free controls for anything from dishwasher to ocean vessels.

settle on a single definition.

However, I got this most descriptive explanation from Lael Taplin, manager of energy conversion and dynamic controls at the Smithfield, Mich., research laboratories of Bendix Corp.: "Fluid state devices and systems use the flow properties of liquids or gases moving through tiny networks of pipes or tubes to perform the functions of sensing, amplification and control. They do this in a fashion similar to electron currents flowing in networks of wires and components."

To amplify, you need energy and a means of increasing that energy. In your TV set, for example, the 110-volt energy available at the wall socket is increased to 22,000 volts by a transformer. In a fluid circuit, energy is a relatively heavy flow of liquid or gas injected into the circuit usually by a pump or compressor. This main energy stream is then amplified and controlled by a much smaller amount of fluid or gas called a control jet.

In other words, as with electronic amplification, a small amount of energy is "inputted" into a circuit and amplified. A greater amount of energy is then "outputted" to perform a function.

A quick look at a fluidic device from outside won't tell you much. It is an ordinary block of metal, glass or plastic. It can be as small as many microminiaturized electronic devices or—like the fluid control that governed the destroyer's maneuver—it can measure 10 x 15 feet.

Slice one of these blocks lengthwise and you'll find a network of shallow channels drilled through the core, similar to the pattern you would find if you cut through a block of termite-riddled wood.

In the simplest type, the design resembles the letter Y. Its leg is the input and the arms are the outputs. Fluid is pumped into the leg. Tiny control jets aimed perpendicularly at it from either side amplify, the energy and divert it to an output arm. If the left-hand control jet hits the stream, diversion is to the right. The right-hand control

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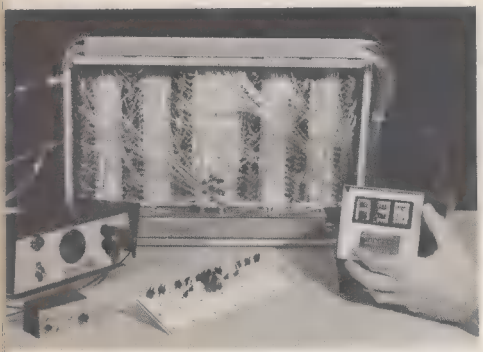


Pitney-Bowes' plastic Flowboard (center foreground) is simplest device for setting up digital circuit applications. Big control unit (rear) has six flowboards and peripheral components. (left) air pulse generator, (right) a fluidic numeric indicator and pneumatic counter.

diverts energy to the left.

A graphic representation of fluidics in action is your garden hose. Turn it on and have someone hit the flow from the side with a stream of water from another hose. This gives the main flow a kick, speeding it up and diverting it to one side.

This description forms the basis for a major type of fluidic device called a bistaple proportional amplifier. There are deviations, but all function on the principle of using one fluid stream to control and amplify a greater amount of fluid energy.

Another type of fluidic amplifier is represented by your toilet. When you flush it, a stream of water leaves the flush tank to push the main body of water around and out the drain. This demonstrates the principle behind a vortex fluidic amplifier, which uses control jets of fluid against the main swirling stream to amplify and control the flow.

Such fluid energy can be used for switching, controlling, sensing or simply amplifying—with infinitely more reliability than pneumatic and hydraulic controls, because fluidic devices have *no* moving parts to wear out.

Fluidics has come a long way. It now stands where transistors stood 15 years ago on the threshold of becoming the most important technological development in recent years.

Scientists have devised many ways to use the controlled output of fluidic circuits. For example, a fluidic guidance system can control the course of a torpedo by shooting out jets of gas or sucking in water. This distorts the surrounding boundary layer of water and changes the frictional effects, causing the torpedo to turn. Similarly, fluidic circuits have been used to control the attitude of a rocket in flight.

Fluidic sensors have also been placed inside jet engines. As long as an engine sends hot exhaust gases into the fluidic sensor, the pilot knows everything is okay. Should a flame-out occur, interrupting the flow of gas, a signal is sent to the cockpit immediately.

Fluidics does a better job of regulating natural gas flow in a pipeline. There are no spark hazards to cause an explosion and no moving parts of normally used regulators to break down.

Fluidic sensors regulate gas flow in jet plane without spark hazard or breakdown of moving parts

A job done by the Fluidics Div. of Howie Corp. in Norristown, Pa., for a chemical company is quite descriptive. A reliable alarm system was needed for bins of gunpowder to see that the atmospheric level didn't reach explosive heights. Electrical alarms couldn't be used because of the spark danger. Moving parts of conventional pneumatic and hydraulic alarms that were being employed kept failing.

According to division manager Frank Calderazzo, "we built a prototype of a fluidic alarm system which uses a tube that extends into the bin. A constant low-pressure airstream flows through the tube. If gunpowder level rises to the danger point, it blocks off the end of the tube, causing the airstream to back up."

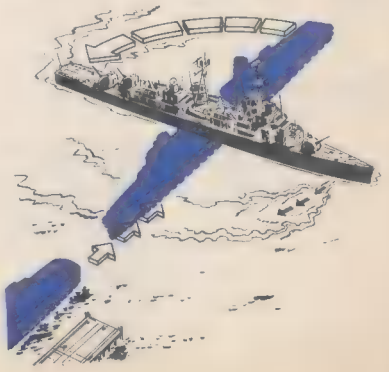
The tube, then, is the control jet. When blocked off, air backs up and diverts the main fluid flow in a fluidic sensor on the other end. When the main flow is thus disrupted, an alarm sounds.

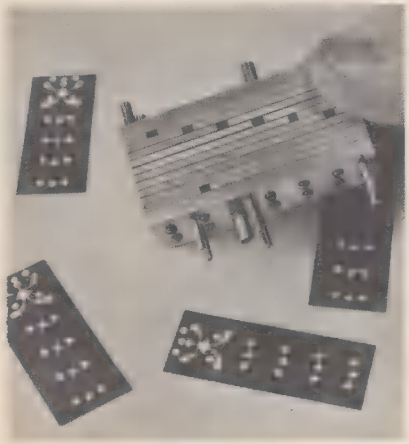
Most people have never heard of fluidics, yet it is one of the country's fastest growing industries, with an anticipated $250 million gross market by 1970. The Russians and Japanese, too, are conducting full-speed-ahead research programs.

Application of fluidics, though, is not keeping up with research. Richard A. O'Brien, manager of the Fluidic Products Dept. of Corning Glass, claims there are only 175 engineers in the United States who possess good fluidic application skills. "For fluidics to become a major technological field," he states, "the number of informed engineers must increase tenfold within 10 years."

Most concentration in converting knowledge to equipment is given to industrial and military needs. When the first inroad is made in the consumer area, there will likely be an on-surge. With what is now known, industry could probably develop a fuel control system for your car that would make the carburetor as outdated as a Model T Ford hand throttle.

U. S. destroyer, when controlled by huge fluidic amplifier for bow-thruster, can turn 180° on its axis in less than three minutes. Ten minutes usually is required to make 90° normal turn by DD-class ships while underway. Success of new device has scientists and engineers excited.





Three-stage amplifier is seen as basis for fluidic carburetor on your automobile to control gas consumption. Fluidic devices can be as small as microminiaturized electronic devices or huge, measuring 10 x 15 feet, like fluid control hopefully to be used in big steamers.

The new fluidic carburetor, according to Gerald L. McArthur of the Bendix Corp. Research Laboratories Div., would probably be a plastic or metal wafer the size of a breakfast pop tart. Jets controlled by an accelerator-type device would direct fuel going into the fluidic carburetor directly to the cylinders.

The great advantage, as that for other fluidic parts being predicted for your car—transmissions, brakes, steering, voltage regulators—is the absence of moving parts. Who knows? We may someday get a car whose main systems, all fluidic, will relieve us of a major present-day headache—finding a good mechanic.

Most people encountering fluidics for the first time tend to compare it to electronics. The comparison limps. Fluidics chief drawback is that it operates in the thousandths-of-a-second range, while electronics operates at millionths and even billionths of a second. Fluidics, therefore, can only replace electronics for those applications where a relatively slow output is required.

As one General Electric official put it, "the real significance of fluidics is its ability to fill the gap between the capabilities of conventional mechanical controls and electronics. Fluidics is not just another way of doing something. It is the best or perhaps the only way to do some jobs and should not be considered for others."

In any case, the science of fluidics is now leaving its infancy and is becoming an adolescent. On reaching adulthood, it will join the term "transistorized" as a common household word.

We dug up three fossils, a leg bone and a 30 MM. shell.

Tips and Trends

To score a direct hit on a fly with a flyswatter, aim slightly behind him. That's the word from fly-killer L.H. Houck in Jefferson City, Mo. Reason: a fly needs a take-off run but his legs are so constructed that he makes the run backward before becoming airborne. Aim ahead of him and you may miss.

Statistics from the U.S. Public Health Service reveal that about 4 million people in this country have hearing loss in both ears. Another 2½ million have loss in one ear. Some five percent more men than women are hard of hearing, but more women use hearing aids.

The population explosion is fizzling out in this country -- slightly. In March, 300,000 births brought 1967's first quarter total to 860,000 -- a good 3 percent below the figure for the same period last year.

A "Narcotics Bulletin" recently issued by New York City's Board of Education contains a wide assortment of the latest information available on "hip" practices, such as taking LSD, smoking banana skin and sniffing glue. The bulletin, a revise of one published a decade ago, is designed to help teachers to spot addicts.

Medical computers may replace some hospital doctors, but they won't replace many general practioners, according to Sir Edward Wayne of Glasgow University. His reasoning: "Half the people you see have nothing wrong with them for the computer to diagnose."

A new international highway wizard recently went into the consulting business. Anyone who wants to know anything about highway technology -- from aggregates to psychology -- need only ask the expert: HRIS (Highway Research Information Service - a computer). It's a storehouse of programmed information about highway problems and construction from all over the world. If you have a question for it, time can be arranged through the Highway Research Board.

AEROSPACE

Handyman tools for space

PROBABLY the handiest man on the moon will be the man equipped with the Apollo surface drill with its five magnesium drill bit extension tubes, an assembly wrench, and an inclinometer to determine whether the hole drilled in lunar surface is actually straight. The drill will be used to cut holes in which will be placed temperature sensors to measure lunar heat flow. Scientists will be aided by the heat flow experiment in establishing whether the moon has a molten center like the earth, or if it is heated merely by solar radiation. The lunar drill is equipped with a foot treadle, cable, and a spring-operated cable storage reel which allows an astronaut to use his weight to drive the drill.

Lunar drill and components will be used by Apollo astronauts in geological experiments on moon's surface. The Martin Company product is powered by battery pack mounted atop drill which is capable of cutting a 10-foot deep hole one inch in diameter. Battery will drive the drill for forty minutes without recharging.

Zero reaction power tool for use in outer space weighs less than eight pounds (but weightless in space) and is about the size of standard impact wrench used by earth garage mechanics. Tool developed by Martin Company and Black and Decker has many attachments. Right: Spaceman makes good use of power tool to repair capsule in an orbit around the earth.

The green turtle—rich source of food—is becoming extinct but studies underway in Florida may lead to a plentiful population through establishment of turtle farms.

Comeback for the sea turtle

Breeding and raising giant green turtles, as yet a rookie conservation effort may eventually help stave off starvation that faces the world in a few decades.

by William and Ellen Hartley

On Lower Matecumbe Key in Florida, almost within sight of U.S. highway I, most tourists are unaware that they are passing an area of investigation that may profoundly affect their lives and futures. Even if they were to turn off the highway, most would miss the significance of the little dockside pens that occupy no more than 25 by 15 feet of Florida Bay water.

Here, Dr. Robert E. Schroeder and his wife, Jean, are studying the biology of huge green turtles in captivity. Associated with the University of Miami, Florida, Dr. Schroeder is attempting to lay the scientific foundation on which may rest a green turtle industry—hatcheries and ranches that, with foresight, could produce an incredible tonnage of tasty protein-rich food.

No one pretends that green turtles alone can save the western world. But they could contribute immeasurably to a solution—if they aren't wiped out first.

What for? Within 33 years, or during the lives of most of us, population authorities agree that there will be 400 million Americans. World population will number 14 billions. This is the most dramatic and frightening fact of our existence. As a predictable result, literally billions of humans now alive face starvation—millions within five or six years—unless food production burgeons astoundingly. In all probability, Americans will suffer least; but it would be folly to assume that 400 million Americans will escape the general tragedy.

Pioneer in the green turtle (*Che-*

No! It's not a dresser drawer full of shells. Mrs. Jean Shroeder is viewing some recently hatched green turtles and hopes to raise 90 to 95 per cent of the hatchlings.

lonia mydas conservation effort is Dr. Archie Carr of the University of Florida who, years ago, established a protected rookery at Tortuguero Beach, Costa Rica, last of the great natural hatcheries. *(Science Digest, March, 1966)*. In his book, *The Windward Road,* Dr. Carr notes what he calls "our astonishing ignorance of the biology of the animal . . . How do you let green turtles breed? Would better protection for beaches on the Florida west coast restore the colony there, where only half-grown turtles are caught today and where none has laid eggs for fifty years?"

This is what Jean and Bob Schroeder are attempting to learn at Lower Matecumbe. There is an urgency in their efforts. "If anything happens to the Tortuguero rookery despite Archie Carr's best efforts," says Bob, "there may be in my hands a small stock of green turtles—and that's about it."

Why are sea turtles important as a source of food? First, as any gourmet knows, their meat is good and the part next to the lower shell, the calipee, is a source of rich, clear soup. An adult green turtle can weigh up to 300 pounds or even 500 in rare instances. A 300 pounder provides about 120 pounds of excellent lean meat.

If given a chance to breed and lay undisturbed eggs, green turtles have a fantastic reproduction rate. A female breeds every third year, nesting on the beach four or five times in the breeding season and laying between 500 and 1,000 eggs.

One female turtle potentially could produce 7200 pounds of meat in a year if baby mortality rate is lowered.

In the wild state, only about 1 percent of the hatchlings live to be adults—nature's protection against overpopulation. Predators, human or otherwise, account for the rest; but predation has just about brought green turtles to the door of extinction. If, however, predation could be reduced so that a mere 20 percent survived to adulthood under either wild or controlled conditions, a single female turtle could produce a potential of 7,200 pounds of meat per year.

Dr. Schroeder thinks it may be possible to raise 90 to 95 percent of healthy hatchlings. As yet, no one knows exactly how they would develop under controlled or "ranch" conditions. If simply turned loose at the age of six months, survivorship might be somewhere between 20 and 50 percent. The older and bigger a turtle gets, the better chance it has of growing up.

Turtle's living habits

A third reason for the importance of green turtles is the abundance of natural food on which they live. A huge belt of marine grasses extends from Florida to Brazil. Much of this pasture is turtle grass *(Thalassia testudinum)* on which green turtles feed.

Finally, green turtles are consistent in their life habits and thus manageable. They return across appalling distances to the nesting beaches of babyhood to breed and lay eggs. One fleet of turtles from Brazil reaches Ascension Island every April to lay eggs—this despite a journey of 1,000 miles—to a dot of beach off which there is no food for adult turtles.

Once the greens were a major food source for seamen and Caribbean shore populations. Some authorities say with reason that they were a major factor in the exploration of the New World; they could be kept alive as a source of fresh meat during long voyages.

Because of their consistency in turning up at the same beaches, green turtles were easy prey for hunters on land and sea. Harpooned at sea before they could breed, captured on land before they could lay eggs, green turtles were killed literally by the millions. Moreover, unhatched eggs were taken from nests by human and other predators in huge numbers. Add to this the tremendous loss of two-inch hatchlings as they enter the sea and are devoured by fish, and it is easy to see why greens have almost been wiped out.

Despite attempts at control, human predation—probably the most serious—still goes on. Last year, Dr. Schroeder counted 137 turtle skeletons on Tortuguero beach in a section outside Dr. Carr's protected area. These pitiful crea-

tures had been turned over by turtle hunters and allowed to die. Tropical sun will usually kill an unprotected over-turned turtle in a few hours. The loss was about 15,000 pounds of turtle meat and an incredible waste of eggs—a damning commentary on the greed of hunters who failed to return for their prey.

Even more horrible, hunters will sometimes remove the turtle's lower shell for the calipee, and let the mutilated animal swim away disemboweled. Even off Tortuguero, poaching parties within the protected three-mile limit sometimes seize females before they can nest. The males are a trifle safer, since they never come ashore. They court in off-shore waters at a rate of approximately two males per female.

Two-pronged aid

The attempt to bring back the green turtle population is two-pronged, although the efforts overlap to some extent. At Tortuguero, Dr. Carr's protected hatchery permits several hundreds of thousands of hatchlings to reach the sea every year. The United States Navy also helps him to move hatchlings by air to beaches throughout the Caribbean where green turtles once nested. The idea is to release them after their survival chances have improved, with the hope that they will later return to nest in the protected adoptive areas.

Dr. and Mrs. Schroeder are working on the biology of the greens. They have a stock of about 400 turtles of varying ages, all from the Carr rookery, and are trying to find out how rapidly the greens will grow in captivity, the influence of water temperature on growth, how much they eat, the amount of weight they gain, and how they get along together in a pen population. (Usually green turtles don't see each other until they return to a beach to breed and nest).

Diet becomes herbivorous

So far, the little ones do best on whole chopped fish. Between six and ten months, they begin to turn brown (from black) and the structure of the beak changes. But they do not become herbivorous suddenly; rather their dietary habits are broadened. The little ones pick at weeds and eat almost anything red—tomato slices, strawberries, etc. They like bananas and sargassum weed. In the natural state, they probably hide during the early stages of development in sargassum weed areas.

Dr. Schroeder hopes eventually to mate green turtles in captivity and persuade the females to crawl out on a beach to lay their eggs. The chances are good, since they are known to mate in pens where they are held for slaughter. Studies of this sort can eventually lead to selective breeding and, perhaps, greater weight, improved meat and a higher egg productivity. The Schroeders also wish to know more about the diseases and parasites that affect the greens.

Dr. Schroeder sets some of his turtles free. Early this year, he released 100 five-inchers on Cape Sable beach in Everglades National Park. Next year he will release a year-old crop on the same beach. He says, "We are not trying to run a turtle farm here. We're trying to get essential data. Very little is known about sea turtles of any description."

As for the future, he says, "I hope to see an industry established soon. I believe this has to be done to exploit the productivity of the sea efficiently.

"We'll probably need some sort of ranching to utilize the turtle grass pastures. This may take the form of beach hatcheries where hatchlings are protected until they have a large enough size to insure a higher survival rate. Turned loose to feed on the undersea pastures, they would be harvested selectively after they returned to lay eggs on the home beach.

Undersell poachers

"Or perhaps it will be possible to develop fenced turtle ranches where ranchers will be able to supervise their herds. It's not impossible that we will have turtleboys riding the marine range just as cowboys manage cattle.

"How an industry will be set up depends to a considerable extent on the biological data we come up with. We may find that turtles can be profitably raised like pigs in pens. If an industry can do this and undersell the poachers, poaching will no longer be a profitable business."

These turtles may grow into 300 pounders, each providing 120 pounds of fine meat.

Because of their tremendous rate of reproduction, the green turtle population can be restored rapidly. It is doubtful that laws against poaching could ever be as effective as turtle management and ranching; poachers and hunters follow traditional patterns established by their forefathers and are rarely amenable to change. Thus wasteful killing will go on until new procedures make it senseless and, more important, unprofitable.

Edible turtles of various kinds exist in sea waters all over the world. The work carried on at Tortuguero and Lower Matecumbe may eventually inspire international imitation—and thereby contribute to reducing the global menace of the coming 33 years.

The changing world of living

When a man swings a machete at you because you asked to borrow it, is he sick? Or is he the victim of an oddly adjusted society? It depends on society, says this famous anthropologist.

by Margaret Mead, Ph.D.

TODAY'S world is certainly filled with tension and frustration. But it is difficult to say whether it's filled with more tension and frustration than life in a little New Guinea village. In such a village you don't know where next month's meal is coming from and if you wrap a bit of leaf around a sore, you had better put the leaf away afterwards, or someone will get it and sorcerize you. In such a village, too, your principal reason for existence is to act as head-hunting material for the next village.

But this much is certain. They never heard of the concept of tension; they wouldn't discuss it; they wouldn't worry about it; and they couldn't do anything about it.

I think that this is the most striking difference between ourselves and the sorts of people that I work with in the field—people who represent a partial version of our own history, anything from 2,000 to 10,000 years back, depending upon our ethnic origins. We think we can do something about our tensions.

I would take the number of people who are in mental hospitals today, not as an index that the society we live in is so much more difficult than other societies, but as an index of the fact that we really think we can do something about it. Whether we are working with psychotherapies that do or do not use various sorts of milieu therapy or drug therapy, we are nevertheless living in a world where, when somebody shows signs of a breakdown, a large proportion of friends and relatives say: "You should do something about it."

You have to be in a pretty protected environment to get away with a tic today in New York City. Most large companies wouldn't want a secretary with a tic. It would worry them. Yet you can go into small towns anywhere in the United States, and find tics all over the place; and people say: "Oh, you know, the Smiths always have tics."

Now, this difference between the expectation today of what is treatable and what should be treated—as compared with the past—is strik-

ing. Let's examine the extent to which the rest of the community, including the physician, is involved in any case of mental illness. They are involved in the standards of treatment, expectation and condemnation that exist in the community. The physician serves as the representative of what can be done, shares to a large degree in the beliefs of the community and teaches the community what can be done. This involvement is an essential component of mental illness itself.

If you live in a small community all your life, as you grow up and show peculiar traits such as undue irrascibility, or a tendency to withdraw, everybody learns about them. In a community of 300 people, you know who is likely to hit you, and you dodge.

Villagers had learned to cope with the "mad spearman"; visiting scientists had not.

Experiences of this sort are a little trying for the anthropologists. An anthropologist friend of mine, for instance, was alone in his hut in a village, when a man started running toward him across the compound, holding a spear ready to strike. Several children promptly climbed up a tree and cried: "Don't hurt him. He'll be all right tomorrow." Such information can be very unreassuring when a man is coming toward you with a spear. And while all this was going on, somebody ran to get his father's sister, because she could always calm down the temporarily mad attacker.

The only unusual element in this situation was the anthropologist, who hadn't climbed a tree in time. We have the same thing happening in small communities today. There are people who are dangerous when drunk. Other people know it and watch them, and perhaps take a knife away from them, or they give them a wide berth. No one is killed.

I lived in one village in Bali where we had a man—a hard worker and a perfectly respectable member of the community, married, with children—who just didn't like people to borrow his machete. People in Bali are always borrowing each other's machetes. So people would ask to borrow this man's machete, and about every hundredth time, he tried to cut them with it.

They didn't stop borrowing his machete. They were sufficiently wary so they usually managed to jump away.

We have records of a tribe in the New Guinea highlands[1] (see p. 43.) where, if a man has taken on more than he can manage, something might well happen to him. In our society, we don't know what to do with such people. They often end up in the psychiatrist's office. But in the center of New Guinea they go into a wild piece of "insane" behavior. They tear around, steal everybody's property, then run away to the bush. After a while, people persuade them to come back and return everything, and assign them a lower position in the society. It is a device for shifting gears inside a society when you have taken on more than you can handle.

Every society has a general setting within which it will tolerate abnormal behavior. If the behavior goes beyond that point it then will have some method of treating it. One such method is to put pressure on the person to do something about it.

The patient wants to be treated, and goes further than anybody will tolerate. By doing so he comes within the purview, very often, first of the general practitioner and later of either police authorities or psychiatrists.

Erik Erikson relates the case of a little boy who ate paper. Nobody, however, paid any attention to him. He ate more and more paper. Still nobody cared. So finally he ate the theatre tickets, and then he received treatment!

Such devices for exceeding the limits in a particular society are important. When patients come into a physician's office for the first time, it is essential to find out who sent them there, what sort of pressure got them there. Was it the desperation they felt, while alienating other people more and more that brought them there? Or did their families send them there because they couldn't tolerate their behavior any more?

We had a good study done several years ago in terms of looking at the family structure of hospital patients, and finding out whether they were key people in their families. Those who were the key breadwinners in the family were brought to the hospital later than the others. Obviously, one puts up with the man who is bringing in the money a lot longer than one puts up with a man who isn't bringing in the money.[2] (see p. 43.) So these patients were likely to be sicker when they arrived.

The same study by Dr. Muriel Hammer also brought out some interesting ways in which "mental illness" serves as a path of adjustment for rural southern Negro migrants to New York, who hadn't learned where to fight, when to fight, or how to get drunk, and so were very likely to overstep the limits of their new urban community. As a consequence, they would be brought into a mental institution (a grim initiation into New York). They learned that this is what hap-

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Every society has a general setting today within which it will tolerate limited abnormal behavior.

pened if they did the particular thing that brought them there. In very large measure, they stopped doing it.

One other factor to take into account is that we have alive today so many more vulnerable people. It is worthwhile considering what happens in a society with an infant death rate sometimes as high as 50 percent. For example, I have never seen an autistic child in a savage community. What would you do with an autistic child? I have never seen a seriously depressed infant. A seriously depressed infant won't eat. Where infants are breast fed, women, as biological creatures, want to have milk for their babies, want to feed them, and want them to grow. Such women are much like obstetricians and pediatricians, who also want infants to get fat, or at least reach the right weight. If a baby that is breast-fed doesn't gain weight, its mother loses milk. So it gains less. She loses more milk, and the baby slowly dies of malnutrition. In such a primitive setting we don't have the type of psychoses that we see in young children here.

Another thing we have to consider today, in thinking about those whom we label as mentally ill and those who first crowd the offices of the general practitioner, and later crowd our mental hospitals, is that we are keeping a lot more vulnerable people alive—although we ourselves are not keyed to handling that vulnerability. The physician, after all, although he is specially trained and knows so much more than the general public, nevertheless is trained at a given period of medical sophistication. Perhaps the most striking example of this is the disappearance in most parts of the United States of simple hysterical symptoms. But in World War I we had a large number of gross hysterias—such as hysterical blindness and hysterical deafness—among enlisted men. This type of disorder was particularly characteristic for enlisted men. A large number of people escaped active service by these symptoms, which of course were beyond their control. The physicians who treated these conditions did not yet know they were psychologically motivated.

In recent years I have talked to young doctors who have never seen a case of classical hysteria. And why? First, the physicians learned what these hysterias were and how they could be treated. The general public also learned, and the interaction between the physicians and the general public, back and forth, is such that patients don't develop such symptoms today.

They have much more obscure diseases today, usually of the gastrointestinal tract, that are less easy to identify. These were characteristic of World War II. So the total

community—the physician within the community, and the patients themselves—are a collaborating group in deciding what is a mental illness. They also collaborate in deciding what symptoms will be regarded as meaning that a person is mentally ill, what symptoms a general practitioner will treat, and what symptoms will prompt a family to force one of its members to have treatment.

The interesting thing that has been happening in the United States in the last decade or so—with the use of psychotherapeutic drugs, particularly—has been the expectation that a great deal of mental illness is treatable. There are parts of the world where there is still no belief that a hospitalized mental illness is treatable. I remember asking, in a Mediterranean mental hospital with 2,000 patients: "What is the rate of discharge?" They looked at me, and said: "There is no discharge. No one who comes in here ever goes out again." That was a characteristic of some of our mental institutions just a few years ago.

We have the notion (rather than a theory or a hypothesis) that has spread with the use of psychotherapeutic drugs, that it is possible to treat many conditions we used to think we couldn't treat, and that it is possible to treat them early in the onset of the pathological disease.

One characteristic of Americans is that they have no tolerance at all of anybody putting up with anything. We believe that whatever is going wrong ought to be fixed.

This is sharply delineated in our attitude towards cosmetic surgery. We have no sympathy for people with awful birthmarks, or girls with enormous noses and no chins. We think they ought to take a piece off the nose and put it on the chin, and look like people.

And as we begin to believe (a belief that has been growing)—that you don't have to be depressed—that when the secretary starts weeping into her typewriter, it's not only disagreeable or uncomfortable for the company, but it isn't necessary—then we say, "Why doesn't she do something about it?"

Two things we won't tolerate

With too much anxiety you will never cross the street, too little and you get run over.

much now are too much anxiety and too much depression. Superficially, one might think this is a little cruel. We deny people the sorts of comfortable depression that they were allowed to have for hundreds of years. We don't approve of the woman who has had two children and retires to a sofa for the rest of her life—behavior which used to be a good upper class solution to the population problem.

We object to all of these things. We are less tolerant. But it is also worth recognizing that we are living in a world where it is necessary for people to have just the right level of anxiety. If you have too much, you don't cross the street at all; if you have too little, you get run over. You have got to be right in the middle. You have to have what some people called "good" anxiety which is kind of a contradiction in terms.

We are living in a world that calls for a certain continuous alert apprehensiveness. It calls for a capacity to meet strangers all day long in most urban environments, and behave. The strangers are not supposed to know that when a given individual they meet loses his temper, he pulls a knife out of his pocket. People have got to behave in a more predictable way.

But this lowered tolerance goes together with our greater capacity to deal with these things, and it goes together, hopefully, with much earlier diagnosis. We spot smaller and smaller deviances from normal behavior. When a wife notes that for three days in a row her husband puts no sugar in his coffee although he normally uses sugar, but simply glares at her, she is likely to tell him: "Dear, I think you should go see a psychiatrist."

Now, you may feel this is overdone. I think it's often overdone to send such a person to a psychiatrist. We don't have enough psychiatrists, and they have more serious problems to deal with. But I don't think it's overdone to say: "You better see your doctor." And it isn't overdone for that doctor to be sufficiently alert to know that when people deviate from their expected behavior in the eyes of their employers, their family, or their friends, something is beginning to go wrong that probably could be righted. The physician, therefore, gets another kind of patient. And the physician has at his disposal methods that he did not have before.

So, hopefully, we will be able to diagnose difficulty much earlier and be able to restore people to the community.

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[1]Newman, Philip. "'Wild Men' Behavior in a New Guinea Highlands Community", *American Anthropologist*, 66, No. 1 (February, 1964), 1-19.

[2]Hammer, Muriel. *An Analysis of Social Networks as Factors Influencing the Hospitalization of Mental Patients*. Ph.D. Thesis, New York: Columbia University, 1961.

Concepts by General Electric's Roy Scarfo

After Apollo, a colony on the moon?

Moon dwellers 240,000 miles from earth will have to cope with intense heat and cold, less gravity, cycling food and water and locating shelters.

by Isaac Asimov

THE assumption is that we (and the Russians, too) will reach the moon within a few years. Even the tragic accidents that cost the lives of three Apollo astronauts and a Soviet cosmonaut do not alter that assumption. NASA has already scheduled the first Apollo flight for very early in 1968 and still looks forward to a moon landing before

the end of this decade.

But it takes a few years to plan an advanced program of space exploration beyond that already existing, so we must now begin to think beyond Apollo. If we do not begin our preparations *now*, we face a halt of perhaps several years after we do reach the moon. And with that halt might come a loss of interest in the space program, a loss of psychological momentum that would stretch years of delay into decades.

The trouble, perhaps, is that the motivation behind our space program was childish to begin with. Too many Americans have aimed to "get to the moon first", not because they wanted to get to the moon at all, but only because they wanted to get back at the Soviets for putting up the first satellite.

We and the Soviets need a new motive, one that places a value on s o m e t h i n g other than scoring "firsts" and one-upping each other. Having reached it, cannot we and the Soviets and any other nation that cares to join the venture combine to explore it, develop it and make it a home for man?

To some, of course, the question isn't "After Apollo, what?" but "After Apollo, why?"

And just as there are those who questioned the project of reaching the moon in the first place, many more will ask, "Why colonize it?"

Presumably there were also those who asked "Why?" in 1492.

The greatest gift of the New World to the Old was not gold or tobacco or any material resources. It was the gift of an intangible—the gift of a second chance, a new start. Later, men came to America looking for freedom as well as for precious metals and for relief from oppressive traditions as well as from poverty.

We are now faced with a still newer New World and the opportunity arises for a segment of mankind to make still another fresh start.

To be sure, the original New World was only 3,000 miles from Europe, while the moon is 240,000 miles from earth. Yet such distances must be viewed in their technological contexts. The wooden hulls that pushed off from Spain more than four centuries ago faced a voyage much longer in time than the one that separates us from the moon. The ocean voyagers were frightened men, not knowing where they were going, ill-fed, poorly cared for, completely isolated from home. Our astronauts are superbly trained and cared for, highly motivated and at all times in contact with home. The advantage is all with the first men to the moon over the first men to America.

But once the New World was reached, one might argue, men could live in it.

What can the moon offer in comparison? It is a dead and useless world, without air and water. It's surface is exposed to the ceaseless rain of micrometeorites, ultraviolet

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radiation from the sun and X rays and cosmic rays from space. Temperatures drop to 200 below zero during a two-week night and rise to 200 above zero during a two-week day. Man could not live for five minutes on the moon without artificial protection.

But what is wrong with artificial protection? At our level of technology, it would be as easy to burrow into the moon and carve out airtight caverns as it was for the first New World colonists to hack down trees and build houses.

Merits of cave living

The airtight caverns would provide marvelous protection. Even just a few feet of rock overhead would bar the harsh sunlight and all unfriendly radiation except for a few cosmic rays which, after all, reach us here on earth. Micrometeorites would be warded off, and extremes of heat and cold would disappear.

At first, astronauts will have to bring their air and water with them. This might entail the prior construction of two space supply stations, one orbiting the earth and one orbiting the moon, like mountain camps established on the slopes of a Himalayan peak.

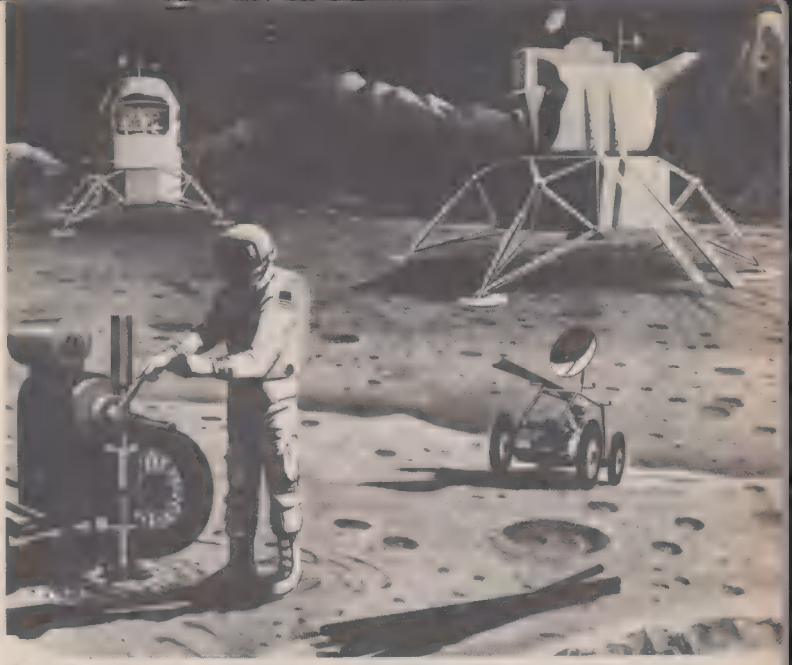
Yet might not the umbilical cord be dispensed with eventually? Might not the colony grow independent?

When we say the moon has no water, we really mean it has no water lying freely on its surface. But it may have water just the same. Water is so common a substance all over the universe (as far as we know) that it seems reasonable to hope that the moon will have retained at least a moderate quantity.

Moon water might consist of layers of frost in recesses of craters into which the sun shines. Underground, perhaps seams of ice could be mined as we mine coal. Failing those sources, we could utilize water molecules which almost certainly are tied loosely to the mineral substances that make up the moon's crust. The water supply would not be large enough to support a population of billions who are accustomed on earth to consuming and polluting water as though it existed in infinite supply. It could, however, support a space colony of thousands who made shrewd and chary use of the available amount.

Such water, obtained from the moon itself, could easily be separated by the process known as electrolysis to yield hydrogen and oxygen. The oxygen then could be used to supply the underground caverns with an atmosphere.

Minerals, too, could be locally obtained. Astronomers have long thought the moon's crust to be essentially similar to the earth's and everything we have learned from satellites orbiting the moon and making soft landings confirms the belief. From the moon's minerals, metals and ceramics could be derived, and nitrogen and carbon dioxide, too. Appropriate minerals, plus water and carbon dioxide, could



An early exploration outpost can be established on the moon with two Lunar modules. One provides shelter for 14 days against heat and cold worse than any known on Earth. The other houses Lunar Rover for surface exploration.

be used to grow plants under artificial light. Eventually, perhaps, animals could also be fed and used as a meat supply.

Everything would have to be cycled, of course; that is, used over and over again. Men would consume oxygen, water and food, breathe out carbon dioxide and eliminate wastes; the carbon dioxide, water and wastes would be used by the plants to reform oxygen and food. The process is not completely efficient, but any slow leakage could be overcome by increasing the water supply from the moon's crust and using additional minerals. Then more oxygen and carbon dioxide could be made.

This sort of tight cycling is by no means fantasy. Such systems are being developed right now since they are essential for any spaceship undertaking a journey longer than a trip to the moon. A spaceship carrying men to Mars, for example, can scarcely count on a round trip much shorter than two years. Carrying a supply of food, water and air—without cycling—would be quite impractical.

Cycling would demand a continuing and reliable source of energy, since it takes energy to mine the moon, electrolyze water into oxygen, irradiate algae with light and make plants grow. Undoubtedly an early project for any moon colony would be to transport and assemble a nuclear fission plant like those which exist today.

But the moon has its own source

of energy, solar energy, which man on earth is already using directly. Solar batteries that convert sunlight directly into electric currents, for instance, power a number of our satellites. Sunlight on the moon pours down for two weeks at a time, without interference from clouds or fog. It is a tremendous and absolutely reliable energy source and one can imagine batteries eventually covering the moon's surface by the square mile, supplying enough energy in the daylight period for immediate use and for storing and later use during the two-week night.

Then, if we learn how to control nuclear fusion, heavy hydrogen could become a far more compact energy source than solar batteries. Heavy hydrogen from moon water might be all the colonists would need.

What if something goes wrong? Suppose a meteorite punctures a cavern or a moonquake cracks one and the air escapes in a rush?

Men live with danger on earth, too. They farm on the slopes of volcanoes, live on vast plains where tornadoes are common, swarm along the seacoasts where hurricanes bring floods. They mass in rabbit-warren cities where fires rage daily, and teem on highways where auto accidents kill thousands. Add it up.

Admit the possibility of technical failures on the moon, but admit the existence of backup systems as well.

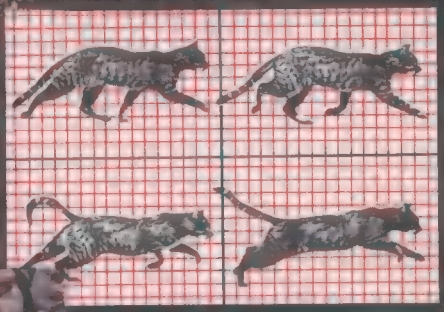
Cutaway exposes an early semi-permanent moon-base facility which provides shelter for six man team after landing on lunar surface. The shelter connects with an expandable structure that, with fuel regeneration unit (background), supports base.

FROM THE MYSTERIOUS GEOMETRY OF NATURE . . .

The double spiraling of the daisy head bears a curious relationship with a mathematical sequence known as the Fibonacci series. It is produced by starting with 1 and adding the last two numbers to arrive at the next: 1, 1, 2, 3, 5, 8, 13, 21, 34, etc. The daisy head has 21 clockwise spirals, 34 counter-clockwise!

. . . TO THE CALCULUS IN A STARTLED CAT . . .

Just as a movie film consists of repeated still pictures of a moving object, so does Calculus break motion down into an infinite number of "instants." Thus mathematicians can calculate an object's speed and acceleration at a specific instant.

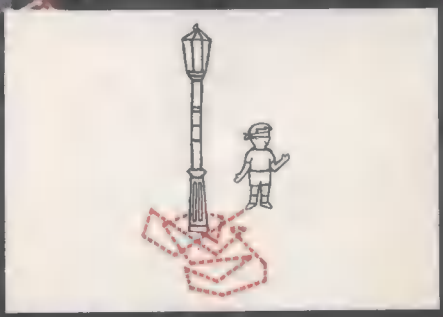


. . . TO THE AMAZING COINCIDENCE OF BIRTHDAYS . . .

Out of any 30 people in a crowd, the odds are better than two to one that at least two of them have birthdays on the same date. Above 50 people, the chance approaches certainty. Try it on 50 friends!

. . . TO THE "RANDOM WALK" PRINCIPLE OF MODERN PHYSICS

If a blindfolded boy walks away from a lamppost, changing direction now and then according to whim, the "law of disorder" predicts that he will keep returning to the lamppost. Young Einstein used this principle to describe the movement of tiny particles suspended in a liquid.



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DOUGHNUT AND COFFEE CUP are really the same in Topology, the Mathematics of Distortion. One could be transformed into other.

PARTHENON FITS into "Golden Re[ct]angle" when [mi]ssing tri[an]gular top is [dra]wn in. This geo[me]trical constru[ct]ion appears [in] many other [fa]mous [ar]chitectural [wo]rks.

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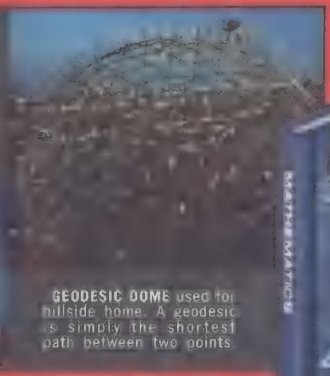

GEODESIC DOME used for hillside home. A geodesic is simply the shortest path between two points.

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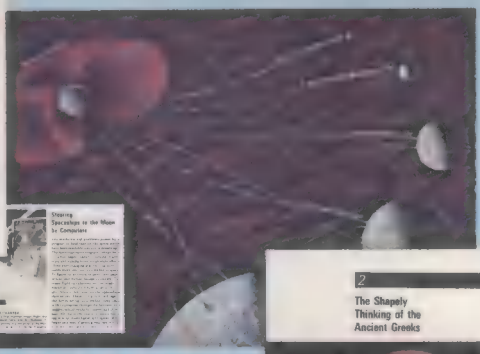

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The Shapely Thinking of the Ancient Greeks

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Admit the puncturing of caverns, but admit also the existence of alarms, of partitioned subcaverns to limit air loss, of space suits for all personnel in emergencies. Then note the absence of blizzards, hurricanes, tornadoes, tidal waves, biting frosts or scorching heat. Add it up.

It would not be hard to argue that, on the whole, the moon would offer a much safer environment than the earth ever did.

But consider the unique psychological difficulties of establishing a moon colony. Could men live out long periods in crowded caverns?

Not every man, perhaps, but a great many could.

Don't underestimate the adaptability of the human spirit.

The canyons of New York streets and the crowded caverns of megalithic New York office buildings closely approach likely habitats in a moon society. Those who live in New York or any other large city are already so far from nature, so unaware of green below and blue above, so unacquainted with open air and flowing water, that the shift to the moon will seem like a mere detail.

Yes, moon caverns would be claustrophobic, but men are found to crew our submarines or spend weeks in our space capsules—and enough men will be found to fill the caverns of the moon.

As for those who eventually will

Modules now covered with lunar surface material to control thermal and cosmic radiation and protect against micrometeorite impacts which constitute a continous hazard on the moon where this 12-man team will study optical and radio astronomy.

be born on the moon, they will know no other life. For them, the possibility of finding themselves suddenly on the openness of the earth's hot-cold surface would be the true terror.

But, come to think of it, could a moon colonist return to earth to face that terror once he was well-established on the moon? This is a serious question for it brings up the matter of gravity—the one difference between moon and earth that cannot be neutralized or minimized by technology and which will require an enormous acclimation.

A smaller world

The moon is a smaller world than the earth and its surface gravity is just one-sixth the earth's. To a man landing on the moon for the first time, the mere act of walking will require careful adjustment, for since he will press less heavily upon the surface he will experience less friction. If he jumps, he will rise higher and stay in the air longer; but he mustn't be fooled since he will come down just as hard as he did on earth. Things will be much lighter but will contain as much inertia as always. Learning a new set of facts of life for the instant guidance of his muscles may be a matter of survival or death.

Beyond the mechanical problems of gravity, there remain unexplored physiological mysteries. How, for example, will the low gravity affect a moon man's heart, kidneys, chemical balance? There is no easy way to answer such questions except by living through the experience.

Though the need to endure prolonged low gravity is a gamble the first colonists must face, at least there is no reason—so far—to expect unavoidably serious consequences. Indeed, based on what we know, there is a decent chance that the gamble would succeed.

Imagine, then, that the moon colony is established as a going, prosperous, secure and reasonably happy concern. What then? What's in it for us back here on earth?

One thing is sure: the moon will be of no use as a dumping ground for excess population. In the next 50 years, by the most optimistic estimate, we can place several thousand people on the moon.

Neither is the moon a probable source of raw materials for earth.

Why bother with the moon, then? How about immaterial reasons?

The moon will export knowledge. It will be a haven for astronomers who will be able to aim their telescopes without an atmosphere to dim their view, without clouds and fog or city lights to blur it.

Based on the side of the moon that faces away from the earth, astronomers will not hear earth's rising radio wave clamor and can probe distant depths unreachable from here. And by analyzing the moon's ancient structure, scientists will trace the early history of the solar system and learn much about the earth.

Is all this academic, ivory-tower research? Don't you believe it.

Moon's enormous vacuum would permit use of technological methods not feasible on Earth.

Don't commit the fallacy of the "practical man" who thinks that because he sees no immediate use for a piece of knowledge, it has no use. All past history assures us that new knowledge, however rarefied it may seem, cannot avoid being helpful to mankind in the long run—and usually in the short run.

Nor is all moon-knowledge and moon-technique so very rarefied in the metaphorical sense. Some of it is clearly useful and rarefied in the literal sense.

The moon's surface is covered with millions of square miles of a vacuum no earth laboratory can match. Numerous technological processes can make use of so enormous and so effective a vacuum, employing devices which can easily be manufactured on the moon but which could not possibly be duplicated on earth.

Pure metals could be prepared without contamination by surface gases. Tiny microcircuits, built of ultrathin metallic film, could be formed with greater precision. Welding could be carried on at lower temperatures. The possibility of large-scale molecular distillation in the vacuum could permit chemical syntheses which are impractical on earth.

The deep cold of the moon's surface at night might make research in cryogenics (the behavior of matter at extremely low temperatures) much simpler than on earth. Techniques for freezing living tissue could be developed, and low-temperature surgery might open new medical horizons.

An entire technology might arise on the moon that could show us its heels. We would be reduced to stumbling after it, borrowing what we could.

And what about the space effort itself? We talk of sending men to Mars but can men endure the tight quarters of a space cabin for a one-way journey of millions of miles that will last for many months? Is it not possible that earthmen can only reach out so far—withstand the depths of space only so long—and then break down? The change from open world to enclosed capsule might be too great to endure.

But moon colonists would already have gone part of the way toward outermost space. They will already be in a capsule, within a giant enclosed spaceship called the moon. They will already be living in a tightly cycled society, and under certain mitigating circumstances. Earth would still be there in the moon's sky. Radio contact would still exist. There would even be the chance of returning to earth if absolutely necessary. Life would not be quite as bad on the moon, with perhaps thousands of companions, as on a spaceship with perhaps only half a dozen.

Then, once the moon had been established as a home, its colonists could more easily cut the last connections to earth. Next, moon men could, with relative ease, shift into a slightly more isolated capsule than they were used to, and explore the solar system to its furthest edge, where earth men themselves could not travel.

But more than that is at stake—and still more . . .

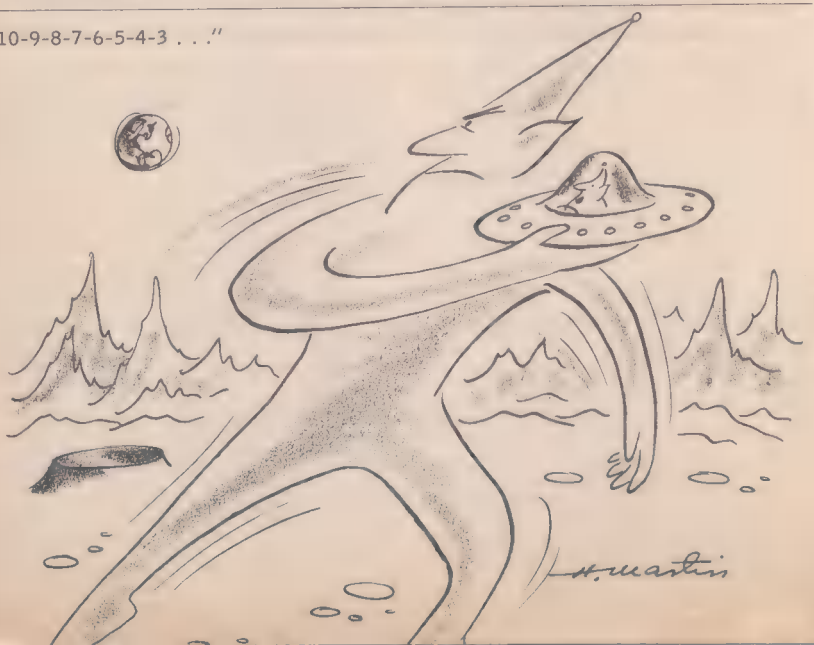
The moon colony will be a completely new kind of society, facing completely new kinds of problems and finding completely new kinds of answers. Men will be living close together on the moon; they will be isolated from other species of life; they will be in thrall to a controlled environment with little room for error. They will have to meet that brutal challenge in a way that might well be infinitely illuminating to the billions who will watch the process from earth.

Just as the greatest consequence of Columbus's discovery of America was the kind of society described in Lincoln's Gettysburg Address, so the greatest consequence of Project Apollo may eventually be the kind of society that will finally answer the problems raised by man's overwhelming development of technology.

And just as the greatest export of the New World was what we might call the "American idea," so it may well be that the greatest export of the moon will be the "Lunar idea," whatever that may prove to be!

The answer to "After Apollo, what?" may just possibly be "After Apollo, everything!"

"10-9-8-7-6-5-4-3 . . ."



The walking fish

IN lands like India, Malaysia and the Philippines where rainfall is governed by the monsoon, life for fresh-water fish can be precarious. One month they may find themselves swimming around in a fine pond, but after a few weeks without rain the pond is gone. One fish, *anabas testudineus,* refuses to give up when faced with such a disaster. He hoists himself up on the spiny edges of his gill-plates and pushes himself along with his fins, hence the nickname, "walking perch". This odd creature can stay out of the water over an hour while searching for a new home. It moves with a rolling paddling motion, and though not too graceful, the walking perch makes pretty good time.

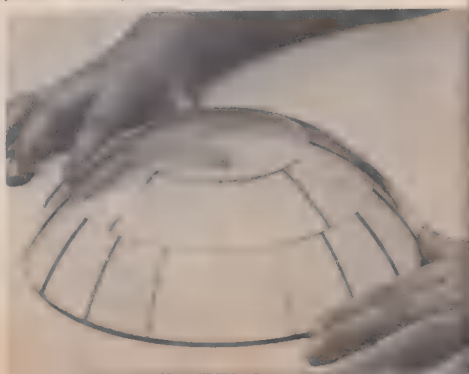
A walking perch demonstrates its un-fish-like ability for Anthea Williams at the London Zoo (above). Head-on close up of the fish shows the rocking motion it employs to move out of water. Several types of fish possess the ability to "walk" on dry land for limited periods, but it is highly developed in the walking perch.

NEW FOR INDUSTRY

Above: New high-speed PrintFlo 300 by SCM Corporation prints 30 characters per second compared to 10 - 15 cps of similar units to date. Below: Two-man Deep Ocean Work Boat by General Motors Electronics is designed for research at 6500-feet. Can support life for 65 hours.

Fusion sealed 44½-inch-diameter glass sphere formed from two glass hemispheres fused into monolithic structure. Built by Corning Glass Works for Navy underwater research, the sphere can support over 1,000 pounds of research equipment off the bottom at depths to 20,000 feet.

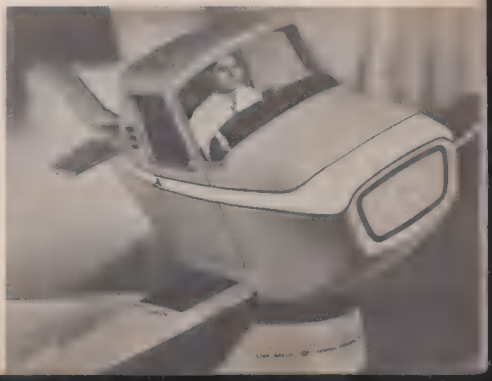
Sapphire optical dome measuring 6½ inches in diameter and 2½ inches tall—perhaps the world's largest—will be used for high speed air-borne application involving infra-red radiation. Precision Lapping & Optical Company used 28 separate pieces of synthetic sapphire for dome.



Stainless steel takes on a new purpose in the world of construction as the first all stainless steel clad hull in the world prepares to go aboating. The boat above, hull clearly visible, is being readied for service at the Barbour Metal Boat Works, St. Louis, Missouri. The advantages of stainless steel hulls rest in their durability. Engineers predict at least five times longer service than conventional carbon steel hulls now give. Owned by the Campbell Barge Line, the boat was built of stainless steel clad material supplied to the boat builders by the Allegheny Ludlum Steel Corporation.

Microwave transmission aids study of effects of rain density from data collected from 100 gauges in 50-square mile area. Collected data is sent over leased wires of New Jersey Telephone Company to central point. A gauge, foreground right, is ready for mounting on a telephone pole.

A Link GAT-1 teaches flying without being airborne. The General Precision craft simulates flight, developing basic skills for contact and instrument flying. The trainer oscillates, registers speed to 160 mph, 10,000-foot altitude, and has panel controls like those of most light planes.



OCEANOGRAPHY

Russia dives for the sea bottom

Sovfoto

Russians are busily engaged in depth-sea explorations for minerals, chemicals and food. A five-year experiment in underwater living is underway now in the Black Sea.

by Albert Parry

RUSSIA'S sleek oceanological ships, wonderfully equipped, ply the Pacific, the Indian and the Atlantic Oceans. At home, clubs of amateurs and professionals are busy building and lowering bathyspheres to study underwater life off the Soviet shores. Last summer one of these groups, headed by a physician from the inland Ukrainian city of Donetsk, stayed on the Black Sea floor a week. In the summer of 1967 a five-year experiment in underwater living and tests commenced at Novorossiysk on the Black Sea. Oceanologists, biologists, chemists, and geologists will live in a steel cylinder-shaped house placed on the sea bottom some 40 feet deep. In teams of four men they will take turns, hoping (they say) "to be able to work as fruitfully on the seabed as in a laboratory on dry land." At Odessa, Sevastopol, and other Southern centers, Russian scientists are observing the dolphin, and some of these experts are occasionally heard to say that some day soon the remarkable mammal may be trained to help the Russians in their ambitious plans of underwater mining and farming.

A bid came from Moscow to buy an American two-man research submarine, manufactured by the Electric Boat Division of General Dynamics. Called Star III, it is a ten-ton ship able to dive some 2,000 feet, and the Soviets wanted to use it as a geological reconnoiterer of the Black Sea depths. What the Russians prize about the American craft, in addition to its deep dive, is its mechanical hands that can

pick up and deliver ores and other samples from the sea floor. The bid was finally turned down, for it was opposed by the United States Navy which warned the White House not to approve the sale, as the Russians might thus learn certain techniques of American sub-making.

So the Soviets are trying to build their own machinery. A Soviet underwater robot to search for ore is being produced on the drafting tables and in the machine shops of the Laboratory of Sea Electronics attached to the Institute of Oceanology. The robot will be lowered and lifted by a specially designed cable truss. It will have a container into which it will deposit the gathered samples. The robot's claws will operate by remote control, from a ship or a shore. On their television screen the men in charge will scan the underwater scene and will watch and direct the robot's actions. The Novorossiysk underwater house is also of domestic make: built in Moscow by Russian oceanologists, it is nearly 58 feet long and some 7 feet in diameter. Although it is not meant for any records of depth or duration of stay, it will be reliable enough.

The ultimate in the Soviet vision of the future is not to depend on robots but for Russians themselves to stay on the sea bottom for long stretches of time, thus to create flourishing mining and chemical industries there. Said Dr. Lev A. Zenkevich, dean of Soviet oceanologists: "Personally I don't think that the day will ever come when humans would live on the sea bottom permanently. But it will be entirely possible for them to stay there for periods of time so as to do their scientific searching and researching, also to mine ores, and just to rest."

With much pride Soviet scientists recall that it was Lenin himself who founded the nation's oceanology. In the year 1921, while final battles of the civil war were still being fought and the country lay in ruins, he issued his decree establishing the so-called "Floating Naval Scientific Institute". The Institute's initial assignment was to research Russia's northern seas and shores. The very first oceanological vessel of the Soviets, the *Persei*, was the Institute's headquarters.

The Institute of Oceanology is a vigorous offspring of that early "Floating Institute". The Old *Persei* has been succeeded by the modern *Vityaz'*, also *Mikhail Lomonosov*, also *Zaria*, as well as other ships. The latest built, *Akademik Kurchatov*, has laboratories equipped (Russians boast) "in accordance with the last word in technology."

One of the Soviet's concerns is to expand and improve natural foods on which fish thrive, and so increase the supply of fish for human consumption. They also study sea-weeds and sea-life of the

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Dr. Albert Parry is chairman of the Department of Russian Studies at Colgate University. His latest book is *The New Class Divided. Science and Technology Versus Communism* (Macmillan). His next book, *America Learns Russian*, will be published by the Syracuse University Press in November 1967.

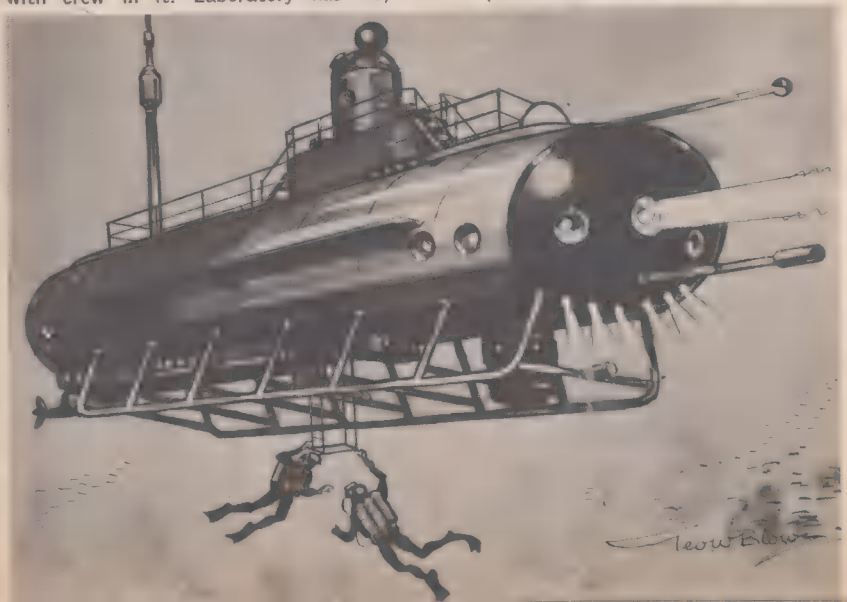
kind that the Russians do not normally use as food but, in the scientists' and the government's view, should learn to eat and like. For the earth's traditional food supplies may soon become too scarce for the growing population everywhere.

But the main preoccupation of Soviet oceanologists is the use of the oceans and the seas as a source of metals, minerals and chemicals. They cite figures to show that in the last 30 years man mined more of this earth's metals than he had done in all its prior history. In the last 100 years he pumped to the surface 15 billions tons of oil. Man is exhausting the earth. At the present rate of use the remaining reserves of the yet untapped oil will suffice only 25 years, of coal 50 years, and of iron 100 years.

Some oil-mining from the seas' bottoms is already being done, by the Russians in the Caspian off Baku and by Americans in the Gulf of Mexico. This oil is being brought up from the continental shelf, a kind of shallow threshold to the shore. In places the shelf is 100 miles wide. The shelf's total area, if put together from all over the planet, is bigger than Africa. The Russians cite this globe's known deposits of oil as 170 billion tons, of which quantity 125 billion are the shelf's part. Imagine, then, they say, what man will find when he finally learns to step off the shelf into the ocean's depth—what incalculable wealth of oil will be his.

They note that iron is already being mined from its underwater deposits by the Canadians and the

Soviet underwater laboratory in Barents Sea can be used in a stationary state or as submarine. In emergency, top structure may be detached and floated to surface with crew in it. Laboratory has TV, motion picture and still photo equipment.



Russians estimate the ocean's treasury of ferromanganese at 350 to 400 billion tons.

Japanese; that the Japanese are also getting undersea coal; that gold is mined off the coast of Alaska, tin off Malaya and zirconium near Australia. In the Soviet sphere of influence, East Germans have been digging titanium and ilmenium in their offshore waters. Elsewhere gas and sulphur are being produced similarly. The Russians also observe that even this accessible shelf area is not fully exploited —that many gold, platinum, and diamond underwater fields off South Africa are still awaiting their turn, as do the deposits of zirconium and titanium-rich rutile off Australia, and of vanadium off Japan.

But the Soviet experts become ecstatic when they begin to talk of underwater manganese.

These deposits are in the depths of the world's oceans, rather than on the shelf. So their mining is the prickly task of the future. The oceans' riches of ferromanganese are estimated (according to the Russians) at 350 to 400 billion tons. They come in concretions, each from one to 20 cubic centimeters in size. Many a concretion possesses a nucleus of basalt and pumice mixed with sharks' teeth; the rest is manganese, which amounts to 20 to 45 percent of the whole.

Soviet experts point out that many of the concretions, in addition to manganese and iron, contain also elements of copper, nickel, cobalt, aluminum, barium, bismuthate, boron, beryllium, cadmium, lead, magnesium, vanadium and zinc. Man will not have to dig deep into the ocean floor, for the deposits lie right on the floor's surface.

Untapped ore riches

The Soviets are set on extending their Sakhalin oil-derricks to that island's offshore waters, where, according to Russian geologists, much petroleum has already been found and only waits to be extracted. The Soviets are also presuming great ore riches off the shores of Kamchatka and the Kuriles, in fact, all along their coasts of the Sea of Okhotsk and the Sea of Japan whose bottoms (they declare) surely hold deposits of gold, tin, zirconium, and other worthwhile metals. Scientists of the Russian Far East are complaining that their part of the Soviet Union is rather neglected by the oceanological chiefs in Moscow. Last August four outstanding Vladivostok biologists publicly demanded that their city be chosen as the site of a new scientific center of Soviet oceanological research.

Biologists and chemists are very much in the Soviet oceanological sphere. Speaking of the concretions on the ocean floor, some authorities explain those formations by certain bacteria. If so, and if these bacteria could be found and studied, they

Soviet bathyplane on exhibit at Expo 67, Montreal, is a towed underwater glider. Craft, steered by pilot in cabin, makes maximum three-hour dives. Powerful searchlights enable underwater photography.

may yet be cultivated by man—to produce ever more of those rich deposits, enough to last mankind for its entire span of life on this earth. As for chemists, at a recent Moscow symposium on the Chemistry of the Seas, a report by Professor S. C. Bruyevich of the Institute of Oceanology revealed that sea water contains more than one-half of all the chemical elements in the periodic table, but "so far we have been able to extract only some ten such elements." When better mastered, the sea water can supply the Soviet Union's economy "with bromine and also with magnesian products used in making drugs, synthetic rubber, fire-resisting materials, and so on."

High-quality fertilizers can come from sea water: more than five kilograms of them from one ton of the Caspian Sea water and more than four kilograms per ton of the Black Sea water. The Institute has already established one such experimental fertilizer-making installation in the Crimea. In another laboratory, using ionites, the Soviet scientist A. Davankov has recently managed to extract gold from sea water. The yield was minuscule, but, said Professor Zenkevich "this is just a beginning."

Both plant-life and animal-life can in Soviet opinion be used by man in his cultivation of the sea. "Biologists," remarked Dr. Zenkevich, "may be able to, perhaps in the near future, grow plants capable of condensing gold, titanium, and vanadium similarly to the way in which laminariaceae condense iodine."

Soviet oceanologists observe that in the body of a sea-dwelling ascidian up to 0.5 per cent of vanadium is found. The ordinary oyster has in its body 200 times as much copper as is contained in the sea water around the oyster. An enthusiastic Soviet writer envisaged a mass-scale cultivation of ascidians, oysters, and other sea-life for the metals these would furnish to the enterprising humans:

"It may be a matter not for industries but for oceanic agriculture and husbandry. I can see plantations of iron, fields of copper, and undersea voleries [sic] of vanadium and wolfram."

PSYCHIATRY

The roots of student despair

by Seymour L. Halleck

AMERICAN college students are troubled. At the University of Wisconsin, where I am director of student psychiatry and a professor of psychiatry, 800 students a year flock to the psychiatric clinic. Even greater numbers use our counseling facilities, and hundreds more turn to private psychotherapists. Wisconsin is not atypical. The same sorry story is reported at one school after another.

The experience has not made me, or other psychiatrists with whom I have discussed the problem, optimistic. More university psychiatrists are alarmed by many aspects of the new generation of students.

To put matters in perspective, the majority of students complete their education without making trouble for the university, or without reaching a state of despair which requires the services of a trained therapist. The student who *is* both troublesome and troubled, however, seems to be a member of an elite group. This group has an importance beyond its numbers because it has a powerful influence on the entire student body. And its members seem to increase each academic year.

Elite students have been exposed to what we presume is the best of American culture. They are largely from the middle or upper class families. They have been reared in prosperous suburbs or well-to-do city neighborhoods, are given the finest education, and are usually endowed with superior intelligence.

Unfortunately, those elite students who are most troubled and whose behavior is most extreme, have become the groups whose values tend to be shared increasingly by all students.

The "hippies" tend to be tolerant and friendly young people whose public flaunting of convention belies a basic passivity. They are also exceptionally open to new ideas. The hippy is deeply concerned with finding his own identity, with becoming a whole person, with communicating, with being very honest and real. He often shows talent for the arts.

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On the other hand, the hippy is a student who seeks an existence in which he is committed neither to past values nor future causes. With his focus on the present he is determined to experience everything he can.

Hippies are incredibly lonely people who seem almost incapable of forming intimate relations. The hippy often believes that any unwillingness to conform to the dictates of an organization or establishment is justifiable. Thus he may have no trepidations about stealing, lying or cheating so long as the injured party is not easily identifiable.

The hippy's reluctance to conform to adult standards might be described as a fear. In its most pathological form it engenders an unwillingness to master skills or to subject oneself to any sort of discipline.

Hippy's "instant" needs

His discomfort is especially poignant when he is aware of his superior intellectual skills and realizes that he has failed to cultivate them. As he turns more and more to the present, his behavior becomes more and more impulsive. He demands instant education, instant comfort, instant solutions. Frustration of these demands sometimes leads to attempts at self-destruction. The impulsiveness of the hippy is so great that he does not easily accept the restrictions and time-binding qualities required for successful psychotherapy.

Elite group's search for truth and just causes is often streaked with self-destructiveness

The "political" category does not, of course, include every student who is politically active. It is primarily made up of elite students whose activism is intermittent and inconsistent, in effect, a group which shares many of the values and behavior characteristics of the hippy. Such students make up a large proportion of the students involved in campus mass movements. Many are leaders.

The political, like the hippy, tends to live in the present but is able to find brief moments of involvement and commitment. He is less likely to experience academic failure than the hippy because his rebellion is direct and does not have more than a temporary effect on his school work. The most encouraging characteristic is the political's participation in movements that do get things done.

Yet, the political seems discouragingly incapable of sustaining commitment. His distrust of adult standards and his impulsive behavior often interferes with his ability to examine any issue or position in depth. In this sense, he bears little resemblance to student political leaders in the recent past. Today's elite students who are politically active seem intent on instant solutions—activism is worshiped as an end rather than a means.

One can also detect a self-destructive quality in some of the more recent causes which politicals have espoused. The political shows a distinct unwillingness to involve himself in small causes or, indeed, in causes that can be won. His activism gives him some protection from psychological anguish, but this is temporary protection. When the causes vanish, when they are lost, or even when they are occasionally won, he is left alone with his emptiness. At this point, he experiences the same despair which drives the more passive student to the psychiatrist.

The elite group has a casual attitude toward sex. This issue is most likely to produce adult defensiveness in the form of over-identification, indignant condemnation or denial that greater sexual freedom exists.

How are we to evaluate this new freedom? Even if we are willing to discount the Judeo-Christian taboos, there is still something disquieting about it.

Rollo May, professor of graduate psychology at New York University, has described the new sexuality as sex without passion. Paradoxically, it is a way of avoiding intimacy rather than finding it. Two students may meet each other, and, after a few experiences, find they do not really know each other and sometimes that they do not even like one another. There is reason to doubt the capacity of such stu-

dents to make successful marriages: The student psychiatrist sees more and more recently married couples who find themselves unable to tolerate the possibility of loving one person intimately or remaining faithful to that person.

False liberality

In spite of the liberal quality of student sexuality, the whole pattern of interaction seems to favor the male and to exploit the female. The new era of promiscuity seems to have done little to enhance the female student's image of herself as a productive and responsible person. The elite female student shows little inclination to seek a career but seems to be trapped in a new feminine mystique which deprives her of meaningful goals and self-respect. Her status as a whole person is subtly degraded.

If we accept the above observations of student conduct, how are we to understand the processes by which this affluent, carefully trained and almost pampered group has come to find life so distressing and alienated? Psychiatric explanations of student despair are partially valid, but they seem to be strangely hollow and stereotyped. The degree of family conflict seen in hippy and political patients is impressive, but not severe enough to explain their degree of misery. More often, one suspects that in another age such students could not have sought the counsel of an older person. We must search for the causes in the nature of the student's world, in those sociological, economic and moral factors which lead him to perceive his existence as meaningless.

The most intriguing explanation of current student conduct has been proposed by Kenneth Keniston, assistant professor psychology at the Yale School of Medicine. In his book, *The Uncommitted,* Keniston notes that our country reveres progress and change. According to Keniston, the elite student is among the first to realize that the values of the past may be totally inappropriate for the world in which he will be an adult. The student furthermore despairs of the future since he finds it unpredictable and feels powerless to direct it. Faced with a bewildering rate of social change he learns to be "cool", to avoid commitment, and to live in the present.

There are at least six other aspects of American culture which help us to understand current student conduct.

- Living in the affluent society of middle class America is itself a stress which encourages a concentration on life in the present.
- As American culture continues to downgrade the influence of the family group, we are all drawn into closer and closer contact with peers. On almost any campus, students rarely see anyone but fellow students. They crave adult company, but cannot find it. As a result, they turn to themselves and create their own values and morals.

The most obvious trait among many students is their desperate clinging to the present.

• We live in a world which places more and more emphasis on youth. In our adulation of youth we forget that it is mainly their physical qualities that are admirable, not their wisdom. In our guilt over our own inadequacies we turn to our youth and are sometimes willing to let their behavior guide us. This makes it possible for some students to arrive at a grandiose assessment of their own ability and power.

• Today's students have grown up in a world which has given them unlimited access to the cynical truths of life. They have been reared on television since birth. By the time they reach 13 there is little they do not know about the sordid aspects of the world.

• Up to the time of President Kennedy's death, students were more hopeful and idealistic. The suddenness and obscenity of his assassination has, of course, had a profound effect on all of us, but its demoralizing influence on our youth is real and baleful.

• The current generation of students received much of their schooling in the post-Sputnik era, a time when education in primary and secondary schools has been revered as a means rather than an end. Since the student has not been taught to love learning simply for the sake of learning, he finds little solace in the kinds of mastery, discipline and accomplishment that have gratified older generations.

The most salient characteristic of American elite students is their desperate clinging to the present. Living for the moment is not a new philosophy in man's history. Up to now, however, it has been characteristic of people we believe to be antisocial and sick. It would seem that if our society continues its unplanned growth we will see more and more people who lead meaningless lives. The ominous signs of this tragedy are already apparent in the increased suicide rate among gifted students.

Role of Universities

If we consider student unrest only in terms of the university campus climate, it is possible to suggest some remedial measures. The most crucial need is for more contact between students and adults, particularly between students and adult teachers.

Universities must also redefine their role in American society. The old model of the university as a community of scholars (usually highly selected and independently wealthy) may not be appropriate to today's world. In an era in which the majority of our youth wish to attend college, and in which many plan to remain in school well into their adult years, the university exerts a crucial influence upon the

personality development of a highly significant proportion of society. Our universities should not only be planning for physical growth but should also be searching for means for producing more mature and responsible citizens. This might be facilitated if the student role were made a more responsible one, if students were given some realistic prerogatives and serious obligations in decision-making processes by which the university plans for its own growth and develops and strengthens its relationship to the community at large.

If we consider student unrest as only one manifestation of a kind of uneasiness that pervades our entire society, any remedies must be global and must consider the nature of man and his current world. I have emphasized that the most important factor in creating student despair is the rapid rate of social change within American society.

Kaleidoscopic traditions

No one doubts that increased population, increased leisure, new technology and an ever earlier obsolescence of knowledge and skills will have a profound impact upon human character. Yet neither our government, our corporations nor our universities are sufficiently interested in studying the subject. We simply assume that people will accommodate their personalities to new conditions of life and that all will go well.

But supposing it doesn't go well. What if our troubled students are not simply a by-product of a brief transitional phase but are rather a significant minority who will remain among us indefinitely? If this is true we must then plan for such people, plan means of helping them find new commitments, and help them to search for means of attaining psychological maturity before their lives are dissipated through prolonged alienation. Let us suppose that there are even more depressing possibilities. Suppose our troubled students actually represent a symbol of protest against a future society that cannot meet humanistic needs. Or suppose that their state of despair becomes so common in our world that it characterizes a majority of the population. In either case our only recourse would be to examine critically society's rate of change and make heroic plans to counteract those changes which threaten to have adverse consequences.

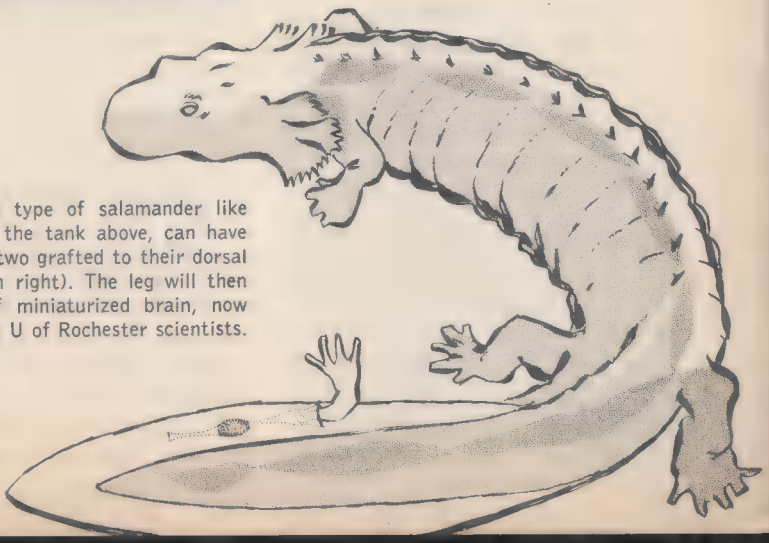
Efforts to plan or control social and technological change would not be universally welcomed in a democratic capitalistic society. Perhaps such drastic measures will never be necessary. I am admittedly considering the most pessimistic possibilities. Yet there is reason to ponder whether we are in danger of developing a society of chronically despairing individuals. There is even more reason to begin now to find ways of using all of our science and all of our technology to develop a more humane and compassionate society.

Brain Builders

SCIENTISTS at the *U. of Rochester's* Center for Brain Research are all agog over a particular salamander known as the "mud puppy". But the salamander in the Rochester laboratory is different from his woodland cousins in that he has one or two extra legs and an extra nervous system grafted to his dorsal fin. There is a definite purpose for these extras: The Rochester scientists are "building" a miniature brain and studying its functions.

A number of years ago, Dr. Paul Weiss of the University of Chicago demonstrated that by grafting a leg from another of the species, plus portions of nerve tissue, onto the dorsal fin of a salamander, the leg and nerve developed into a functioning unit.

Now, the University of Rochester group is implanting legs, spinal cords, and portions of brain tissue into these dorsal fins to create a much simplified model of the complex brain-nerve-organ system found in human beings. The salamander's fin provides nutrients and removes wastes from the implant. At the same time, the fin is sufficiently remote from the functional parts of



Mud puppies, a type of salamander like those shown in the tank above, can have an extra leg or two grafted to their dorsal fin (see diagram right). The leg will then grow a sort of miniaturized brain, now being studied by U of Rochester scientists.

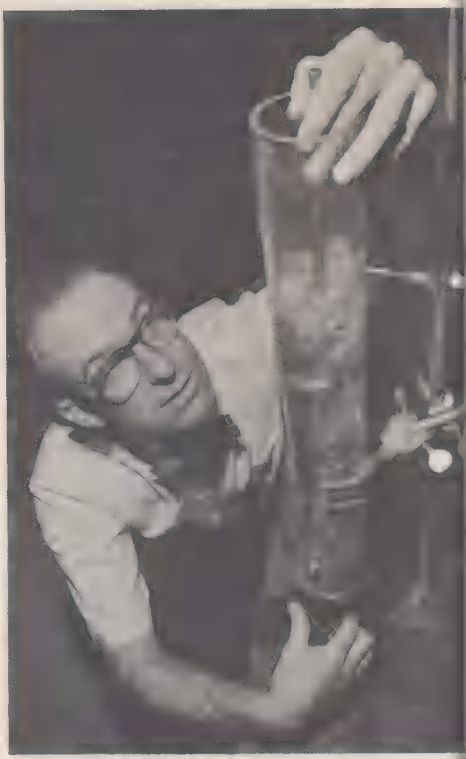
the animal to have little effect on its normal activity.

The researchers explain that a major advantage in working with the salamander is its ability to regrow parts of its brain by replacing nerve cells which have been destroyed. The higher animals, including humans, have lost the ability to regenerate damaged parts of the brain.

The Rochester research team studies these miniaturized brains with a new electron microscope that magnifies individual nerve cells up to 100,000 times. It is believed that the key to the cell's ability to send and receive messages is the ease or difficulty with which electrically-charged atoms can pass through the cell membrane. However, better knowledge of the chemical factors which affect permeability of the membrane and how these factors are related to the information receiving and storing processes, still is needed.

A computer is being used to organize and analyze the enormous number and variety of electrical signals that are produced even in the salamander's simplified grafted brain-nerve-organ system. It is hoped the computer may be able to unravel the neurological code, the sequence arrangement, and frequency of electrical signals that may be the "language" of the brain.

The scientists hope that their work will provide a better understanding of—and perhaps new clues to—the human learning process.



Bubbles are the primary interest of University of Utah chemical engineer Dr. Noel de Nevers. Much is known about how a lone bubble acts, but Dr. de Nevers is attempting to determine what happens when thousands of them get together. Reactions, he has discovered, are entirely different from those of a single bubble.

Bubble bath for Utah

Bubble dynamics may conjure up for some, nostalgic juvenile images of fragile iridescent balls bobbling through the air on a spring zephyr, but to a *U. of Utah* chemical engineering professor it's serious business. Dr. Noel de Nevers is bringing the ethereal world of bubbles

down to earth in the hard, cold world of beakers and test tubes.

Dr. de Nevers is trying to determine the causes and effects of multitudes of bubbles in a wide variety of particular fluids. He contends that once bubble dynamics is understood the results will be valuable to many industries (such as petroleum and beet sugar) which use bubbles to cause chemical changes during manufacturing processes.

UFO photographs, anyone?

Pictures of Unidentified Flying Objects, taken by private individuals, are being sought by scientists at the *U. of Colorado*. They have also set forth some basic rules for amateur and professional camera bugs for taking UFO photographs.

Robert J. Low, project coordinator for the Air Force-financed study of UFOs at the university, noted that photographs have the potential "to get us much closer than we are now to the solution of the UFO enigma." The university will make a complete analysis of UFO pictures submitted to the research group. Negatives and other materials will be returned to the sender as soon as the analysis has been completed. The sender will retain complete ownership and publication rights to all pictures and, if he wishes, the sender's identity will be held confidential.

Suggestions for photographers:

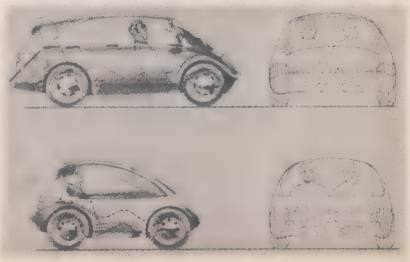
1. Set your camera at infinity.
2. Use a fast film, like Tri-X.
3. For moving objects, use a shutter speed at least as fast as one-hundreth of a second, and hold camera motionless during exposure.
4. At night use the largest F-stop you have.
5. Take as many pictures of the object as you can.
6. Include some ground in the picture, if possible.

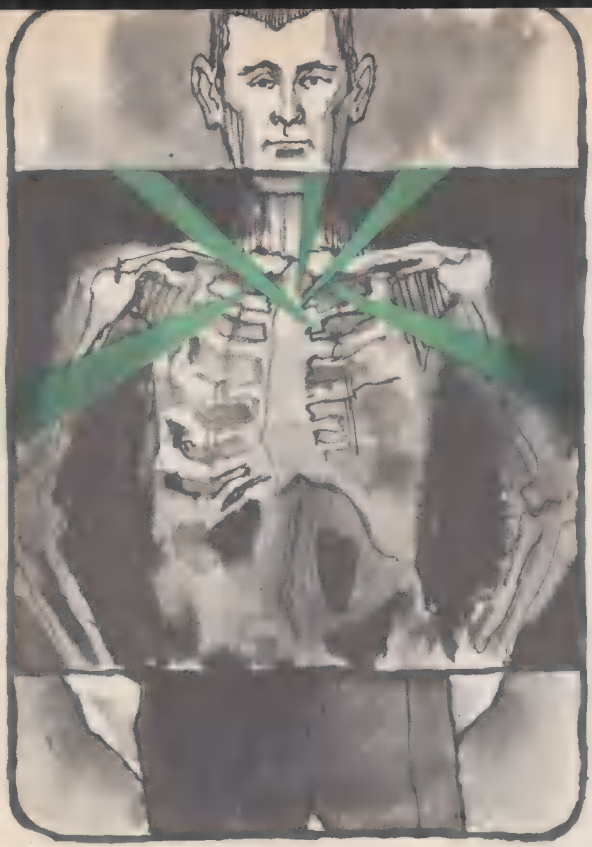
Bug-size city buggies

Philadelphia's parking problem may be solved by fleets of small, limited emission vehicles, if a *U. of Pennsylvania* study—financed by a grant from the U. S. Department of Housing and Urban Development—proves the system workable.

The fleet system would involve special miniature cars—with electric, turbine or other hybrid engines—operated by either coin or punch cards. The vehicles would be parked at railroad terminals, waiting for commuters who would drive them to their places of business.

Reduction of traffic congestion and air pollution would be two major benefits from use of tiny electric or gas turbine cars (diagrammed below). They could be rented in the center of a city during the rush hour and could provide transportation for commuters. Crews could pick up cars and redistribute them to commuter stations.





Your chest pain may *not* be heart trouble

by Joseph D. Wassersug, M.D.

PRACTICALLY everybody who comes to my office with chest pain comes in fear that he is having a heart attack. The truth is, the heart is only one organ in the chest and a heart attack is only one cause of chest pain. What I prescribe for chest pain depends on what is causing it.

For example, take the "Case of the Apprehensive Daughter". She brought her father (age 82) in to the office because he was having sharp pains along the left side of his chest. The pains had continued fairly steadily for two days and had kept him awake. She was sure that he had a "coronary".

One glance at his chest, however, revealed a reddish rash along the course of a rib and on his back. The old fellow had *shingles*. Because of

the man's age I took an electrocardiogram just to be sure. It was normal. Shingles was the only cause of his pain. In time it would get better.

Or, there's the "Case of the Professional Worrier". She was 42 years old, housewife with three-teen-aged children. She had worried about her pain for years, concerned that she might be having repeated heart attacks but too apprehensive to do anything about them.

She had carefully noted certain features about her pains. They were not aggravated by exertion or effort. They were under the breast bone and in the upper stomach, "like indigestion", she said. They were worse at night when she lay down but got better when she got up and around. Mostly they seemed to be irregular in time or duration. The pains were not much worse now than when they first began to bother her. Strange pains. No wonder she worried about them.

An X ray of the stomach confirmed the diagnosis that any doctor would have suspected from the history. The patient had a small *diaphragmatic hernia* (also called *hiatus hernia*). Her pain was due to the fact that a part of the stomach protruded up through the diaphragm into the chest. Lying down simply made it worse. By advising that she elevate the head of the bed and take some antispasmodics and sedatives which I prescribed, I was able to alleviate a good deal of the patient's discomfort.

Hyperventilation syndrome is one of the most common and most disturbing causes of chest pain even though it is almost completely harmless. The patient is usually a young housewife but may be a young or middle-aged man. The pain may be on the right or left side of the chest. Usually, the patient is more apprehensive when it is on the left side because of the concern that it is heart disease.

Simply by carefully watching and listening to the patient the correct diagnosis can usually be made. The patient often takes a deep breath and sighs as she talks. As she points to her pain her hand moves sideways in the direction of the ribs along the left chest wall. Sometimes the patient will also complain of being light-headed or "dizzy" or "numb all over".

Emotions alter intensity

Although the chemical disturbance in the blood is a complicated one in hyperventilation syndrome, doctors know it is an emotional illness somehow related to excessive blowing out of carbon dioxide with each prolonged expiration. Since carbon dioxide helps regulate blood acidity, its loss to the body makes the blood more alkaline. This, in turn, alters the calcium, and calcium depletion leads to contraction of the muscle between the ribs, which provokes the pain in the chest.

Patients with hyperventilation syndrome need mostly reassurance. They must be told that the pain is due to anxiety, frustration, or other

suppressed emotions. Sometimes I give the patient a 4-pound paper bag and show them how to rebreathe the carbon dioxide and reclaim it for use by the body.

Pain in the chest can also be caused by an acute injury or by chronic wear and tear. Take for example, the "Case of the Bewildered Mother". She was twenty-eight and her second child was ten months old. The pain in her left chest and shoulder had nagged her for one month and then she grew panicky.

Holding baby painful

On physical examination this young mother seemed to be in perfect health. A chest X ray and an electrocardiogram were n o r m a l. "Are you right-handed?" I asked. She said she was but I discovered she carried her baby in her left arm.

The pain in her left chest was from lifting and holding the baby. The baby was getting bigger and became too much of a load for her. "Give your left side a rest and the pain will go away," I assured her.

The point that I want to make is that not all chest pain is due to heart disease, not all chest pain is life-threatening. On the other hand, sometimes the problems are most urgent with life and death hanging in delicate balance. The doctor needs not only skill but speed.

Bill Sommers was a thirty-seven-year-old auto mechanic. He smoked two packs of cigarettes a day, worked hard but was in pretty good shape until that cold night when he tried to change a tire on a car. Suddenly he got a severe, tearing pain in his left chest. He had to stop, could hardly move, called for help and one of his buddies took him to the hospital.

When I got to see him a few minutes later, his pain had eased a bit but he was very frightened and short of breath. My clinical diagnosis of a collapsed left lung (*spontaneous pneumothorax*) was quickly confirmed by X ray examination. I gave Bill a hypo to suppress his pain, carefully put a needle into his left chest and, with special equipment, sucked out a little over a pint of air. Almost immediately Bill felt better. For the next few days I kept Bill in the hospital and then sent him home. His lung had almost completely re-expanded.

Blood clots in the legs, pelvis, heart and other areas can be another serious source of chest pain. Such clots travel from the veins back to the lungs, causing a condition called *pulmonary embolism*. Whenever possible I try to prevent clots from forming in the first place. Doctors know that prolonged rest in bed, extensive immobilization, infection and injury are all factors in causing clot formation. I usually prescribe early ambulation, elastic stockings, and anti-coagulants as preventive measures.

When a definite diagnosis of clotted veins (*thrombophlebitis*) is made I put the patient on an intravenous drip of a special anti-

Pleurisy, a disease in which lung linings are inflamed, can signal onset of tuberculosis

coagulant called *Heparin*. Later, if advisable, I consult a surgeon regarding the possibility of cutting and tying off the veins (if the leg veins are involved) so that additional clots can't get to the lungs.

With pleurisy the linings of the lung are inflamed. Therefore, the pain in the chest is aggravated with every breath the patient takes. It's much like having a speck of dust in your eye. The surface lining of the lung, like that of the eye is extremely sensitive to pain.

Most important I try to find out why the patient has pleurisy. Most often pleurisy follows an infection, such as pneumonia, tuberculosis or virus.

To relieve the chest pain of pleurisy I prescribe heat, rest, salicylates, codeine and other analgesics as necessary. I may put a needle in the chest, withdraw as much of the fluid as I can and send it to the laboratory for chemical and bacteriological analyses. Sometimes I apply adhesive strapping to the chest, or even a chest binder. In some cases, too, injecting the intercostal nerves with procaine gives good pain relief.

One important point about pleurisy is that it may be an advance signal of tuberculosis. It is, therefore, essential for every patient who develops pleurisy for no other obvious reason to be followed carefully with X rays of the chest every six months or so for at least two years.

The most important cause of chest pain is, of course, heart disease.

For example: Take the case of Alex R., a forty-one-year-old stone cutter. He had been working out in bad weather when he "caught cold". He ignored his cough and fever but could not ignore the pain over his heart.

When he came to my office his electrocardiogram was normal. But the electrocardiogram is only one test, it is not the whole answer. On examination I heard a "pericardial rub" over his heart which signified *pericarditis*, an inflammation of the outer lining of the heart. Under the fluoroscope his heart shadow was a bit enlarged also suggesting pericarditis. In spite of a normal electrocardiogram, the patient had *pericarditis*.

I sent him to the hospital and followed his course carefully. Serial electrocardiograms, taken d a i l y, confirmed the diagnosis. I treated him with a broad spectrum antibiotic and some phenylbutazone. His temperature promptly subsided and I was able to send him home in ten days.

More common than pericarditis is *angina pectoris*. The pain is squeezing, usually follows exercise, emotions, cold weather, eating a heavy meal. It lasts two to five

Advertisement

Why Can't You Remember?

A noted publisher in Chicago reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added poise, necessary self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions or even in casual conversations with new acquaintances, there are ways in which you can dominate each situation by your ability to remember.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-training method in a new book, "Adventures in Memory," which will be mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Memory Studies, 835 Diversey Parkway, Dept. 690-019, Chicago, Ill. 60614. A postcard will do.

minutes, may radiate to the neck or left arm and then usually subsides. For angina pectoris, I prescribe weight reduction if the patient is overweight, substitution of small meals for large and avoidance of overexertion and over-emotionality.

For angina pectoris I also prescribe medication. Most commonly the medication I advise is *nitroglycerine*, a tiny tablet which the patient places under his tongue as he needs it. Relief usually comes in a few seconds.

There are also a variety of other nitrates that go by such names as Peritrate and Cardilate. These are slower acting but longer lasting.

The most dramatic heart attacks are those that are variously called "coronary thrombosis", "coronary occlusion" and "myocardial infarction". I rush the patient to the hospital and, if he seems to be really ill, direct him to our special Coronary Care Unit.

In the hospital I prescribe narcotics to ease the pain, start intravenous medications as necessary and hook the patient up to a cardiac monitor. In order to prevent clots in the leg veins I prescribe elastic stockings. If the patient needs oxygen or digtalis or cardiac stimulants, I order them too. The heart may need electric shocks to straighten out an irregularity.

The patient with chest pain is always challenging. His problems may be simple, requiring only advice and reassurance. On the other hand, his pains may be dramatic, intense, severe, life-threatening.

The peril of painlessness

by Arthur J. Snider

FROM infancy on, the 10-year-old girl had incurred numerous cuts, burns, lacerations and even fractures of both legs, yet never once said it hurt.

She could pick scorching hot dishes and pans from the stove, commenting only that it felt warm.

"She is an awful kid to crawl on rocks and stones," her father related to doctors. "She rubs big sores on her hands and knees and goes right on without paying any attention to them."

The little girl is another of the rare group of individuals who go through life feeling no pain. She has a congenital insensitivity to it. Lucky? On the contrary. She'll be lucky to escape a premature death. She won't have a pain in the side to warn her of an inflamed appendix, a pain in the arm to warn of a heart attack or a headache to signal hypertension.

"We consider pain our persistent enemy but its value as a warning far outweighs its evil," notes Dr. Vincent J. Collins, president of the Illinois Anesthesia Society. "Without perceiving pain, people would go through life incurring one critical injury after another simply because they have no means of knowing when they get hurt. Pain is our built-in safeguard."

The cure rate for cancer would rise significantly if the disease would herald its presence by pain in the early stages, according to Dr. Max Sadove, head of the anesthesiology department, University of Illinois Medical School.

The amount of pain one can take varies from person to person. It depends on temperament, culture, past experience, expectation and fear of danger. Most normal men and women have the same sensitivity to pain but the psychological reaction to it differs widely.

Pain tends to become worse at night when there is more time to think about it. Pain is diminished when there is a secondary discomfort in the body. Hence noise, a form of pain, has been used to reduce reaction to the primary pain. Clenching the fists, wringing the hands or gripping a metal bar helps.

Distraction explains why soldiers often do not feel their wounds on the battlefield, why boxers can fight with a broken hand but wince the next day if someone lightly touches

the now painful injury.

Not until the development of the dolorimeter could sources of pain be measured for intensity. The device uses a lens that focuses increasing heat from a 1,000 watt bulb onto a blackened area of the skin.

Scientists have found that pain reaches its excruciating maximum when skin temperature hits 152°. After that point, the pain intensity remains constant, no matter how much heat is turned on. This would indicate that medieval torture efforts were a waste of time. Past a certain point, the pain apparently destroys the sensory nerve fibers.

Maximum source of pain has been found to be a grease burn. Labor pains during childbirths, passing of a large kidney stone and a burning cigaret held against the skin also are pains in this range of intensity. In the next category are heart attacks, muscle cramps, some headaches and facial neuralgia.

It is fortunate for most people that their pain is slight enough so that the little white tablet, aspirin, a cheap, easily-obtained and relatively safe poor man's wonder drug, can control it. But this first line of defense is not sufficient for many others. They're driven to the doctor for relief.

Depending on what his diagnosis shows, a doctor may alleviate persistent pain by vitamins, nutrients, hormones, antibiotics, physical therapy, X ray, immobilization, enzymes or tranquilizers. He may choose a drug that reduces inflammation or relaxes muscles, diminishes transmission of the pain impulses or the patient's reaction to the pain. He may even choose a placebo, a blank substance, and accompany it with earnest and confident assurance that it will bring relief. This kind of suggestion is basic to hypnosis, also widely used in relieving pain.

Most pains can be quickly relieved with narcotics and doctors are wary about using them for more than a short time because of the possibility of developing an addiction.

"There's an intensive search for pain-relievers that can do the work of narcotics without causing addiction," Dr. Sadove points out. "We are getting better and better drugs. It's not too much to expect that some day we will have no need for the addictive analgesic."

Goodbye to breakfast

At one time in the history of America, breakfast was a meal of abundance. It included juices, cream-drenched cereal, buttered toast, eggs, ham, bacon and coffee. But one by one, says the "Journal of the American Medical Association" these ingredients have been implicated in the cause of heart disease.

Eggs became the first suspect. Their yolks laden with cholesterol, they were sacrificed by those who believe a high cholesterol level in the blood can lead to hardening of

the arteries and heart attacks.

The next to go, says the AMA editorial, were fatty ham, bacon and milk products containing cholesterol. About all that was left were "the bleakness of dry toast and the drabness of black coffee."

Now there is the belief of some that the dietary sugar into which bread carbohydrates are converted may contribute to the elevation of cholesterol. This meant the sacrifice of toast and sweet breakfast juices.

The lone survivor of the hearty breakfast—sugarless and creamless coffee—may be on the way out because of reports that caffeine can raise the levels of free fatty acids which may in turn lead to higher cholesterol levels.

End of baby boom

The baby boom is finished. This year's birth rate may drop below the all-time low recorded at the depth of the depression in the mid-1930's.

The boom began in 1946 and began to taper off in 1958. It has continued steadily downward ever since. When the decline will level off is anybody's guess, says Robert C. Cook of the Population Reference Bureau, Washington, D.C.

"The situation today as compared with that of 33 years ago represents a paradoxical contrast in one important respect," he points out. "The low birth rates of the mid-1930's occurred when economic conditions were at a low ebb. As soon as conditions improved, the birth rate began to rise. By 1947 it stood at 26.6 live births per 1,000 population, which was as high as it was 25 years earlier. The economic state of the nation is very different today from that of the grim mid-

1930's. Yet, between 1958 and 1966, the birth rate declined 30 percent in an era of unprecedented prosperity."

Recent trends project a total U.S. population by the end of the century of about 300 million in contrast to 370 million that could have been anticipated in 1957.

Though the birth rate may continue to decline for a while, Cook believes the decline will not continue much longer. The proportion of women in the high fertility ages is now beginning a sharp increase. This is because the boom babies of the late 1940's are moving into fertile age brackets. "This rapidly increasing fertility potential could set off another baby boom," Cook cautions. "Whether this actually happens depends on the collective decisions of millions of couples, especially those who will be marrying and building their families in the next 10 years."

What is responsible for the pres-

Advertisement

Why Are You Ignored When You Talk?

A noted publisher in Chicago reports a simple technique of everyday conversation which can pay you real dividends in social and business advancement and works like magic to give you poise, self-confidence and greater popularity.

According to this publisher, many people do not realize how much they could influence others simply by what they say and how they say it. Whether in business, at social functions, or even in casual conversations with new acquaintances there are ways to make a good impression every time you talk.

To acquaint the readers of this publication with the easy-to-follow rules for developing skill in everyday conversation, the publishers have printed full details of their interesting self-training method in a new book, "Adventures in Conversation," which will be mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Conversation, 835 Diversey Parkway, Dept. 690-019, Chicago, Ill. 60614. A postcard will do.

ent decline? The popular explanation of oral contraceptives is obviously wide of the mark, Cook points out. During the depression years when the birth rate hit an all-time low, the pill wasn't dreamed of. The current decline started three years before the pill was put on the market.

Nor can the war in Vietnam be considered a major factor since less than a half million men are in East Asia.

That the nation is balanced on a demographic hair trigger is shown by the fact that the addition of one extra child per family would mean a population increase by the year 2000 exceeding the present total.

New acne control

Bad cases of acne of teen-age girls can be markedly improved by using birth control pills. Dr. William E. Barfield, a gynecologist at Medical College of Georgia, says the treatment is based on the belief that adolescent acne is related to hormonal imbalance.

He treated 57 adolescents and six adults with severe acne for up to three years by cyclic inhibition of ovulation. Most had been treated for many years with conventional methods without success. One of the adult women, age 34, had been under care of several dermatologists since age 16. Fifty-five of the 57 adolescents were completely relieved of the disturbing cosmetic disorder. When the treatment ended, they were able to resume ovulation.

The new strains of war

Combat fatigue, the breakdown known as shell shock in World War I, is being seen less in Vietnam. Becoming more apparent, however, is a newly-recognized entity given the label "pseudo-combat fatigue." It occurs in soldiers who had a pre-existing personality or psychoneurotic disorder in civilian life. In the stress of battle, they become fearful and tend to "freeze."

True combat fatigue, on the other hand, is a transient reaction of a basically healthy individual to the severe stress of combat, explains Lt. Comdr. R. E. Strange of the Navy Medical Corps. Such an individual almost always recovers and returns to duty. Only half of pseudo-combat fatigue victims return to duty.

It is important to differentiate the two conditions, not only for the patient's benefit but also for the good of the military unit to which he may return, the physician emphasizes.

Strange, who served on a hospital recovery ship off Vietnam, cites as typical of the pseudo group a 22-year-old marine with four months of service in Vietnam. He was well for two months until his unit made contact with the enemy. Evacuated to the hospital shop, his apprehension recurred whenever new casualties arrived or when the war was visible or audible from the ship. He also had a relapse when confronted with a possible return to battle. A study of his background showed a history of emotional instability that put him in difficulty with his family, social and school relationships. It was necessary to evacuate him from the combat zone.

New role for doctors

A new category of physician-assistants will handle the bulk of patients by 1990. This is the view of Dr. Oscar Creech, Jr., of Tulane University. These assistants will treat minor injuries and self-limiting diseases, perform preliminary examinations on those with serious illnesses and arrange for diagnostic procedures.

"For want of a better name, I shall call them clinical associates," Dr. Creech says in *The House Physician Reporter*. "These people would have four years of formal education beyond high school plus a year of apprenticeship or internship that would allow them to assume the functions performed by most practicing physicians today."

Clinical associates will be necessary because the everyday practice of medicine will not be interesting or challenging enough to the molecular specialist being trained today or to the system specialist of tomorrow, Dr. Creech declared. Doctors will be full-time employes of the medical center complex within which they will provide total medical care for the residents of the community, preferably on an annual fee basis but perhaps as salaried employes of the federal government, he believes.

Idea of the Month

Dr. Aharon Katchalsky helped invent engine that skips step in creating power.

The 'muscle machine'

An engine invented by a group of Israeli scientists transforms chemical energy directly into mechanical energy, eliminating the intermediate step usual in the creation of power (see *Science Digest, March '67*). In internal combustion and steam engines, they point out, an elastic, compressible vapor or gas serves as a "converter."

Dr. Aharon Katchalsky, head of the polymer research department of the Weizmann Institute of Science at Rehovoth, Israel, and three co-inventors recently received Patent 3,321,908 for the mechanochemical machine.

Among early expected uses are the operation and control of delicate instruments in space vehicles and weather balloons. Applications on a larger scale may well follow.

In the words of the patent, the engines "extend the realm of utilizable fuels, permitting the consideration, as fuel sources, of many materials and chemical reactions not heretofore so employed."

The scientists have imitated the body's muscle contraction and relaxation by passing fibers of large-molecule materials through different liquids. Endless bundles of the polymeric fibers, hooked over pulleys, lengthen as they move through one fluid and contract in another. The pulleys are linked to a crankshaft.

In one operation described in the patent, collagen fibers contract as they go through a salt solution (lithium bromide) and stretch again as they pass through pure water. The expansion and contraction is much like the muscular action. The speed of the bundle is given as 20 centimeters (about 8 inches) a second.

For continuous operation, fresh liquids are fed into the baths. If the process is reversed, and power is applied to move the fibers instead of being created by their movement, the inventors foresee practical use in desalinating sea water.

Dr. Katchalsky, who has headed the Institute's polymer research since 1948, has served as visiting professor at a number of American universities. His co-inventors of the engine are Itzhak Z. Steinberg, Avraham Oplatka and Amir Kam.

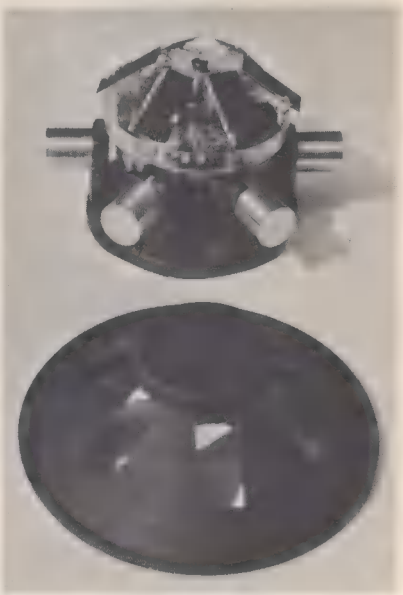
The institute, a $100-million "city of science", was founded by and now serves as a memorial to Dr. Chaim Weizmann, Israel's first president. —*Stacy V. Jones*

A newly independent owner of Permobile, a prototype electric wheel chair, is in the midst of navigating a pavement curb. Invented by Dr. Per Udden of Sweden, the chair is battery-operated and by simple touch steering allows the disabled occupant to maneuver easily up steep stairs, across heavily trafficked streets, in and out of buildings.

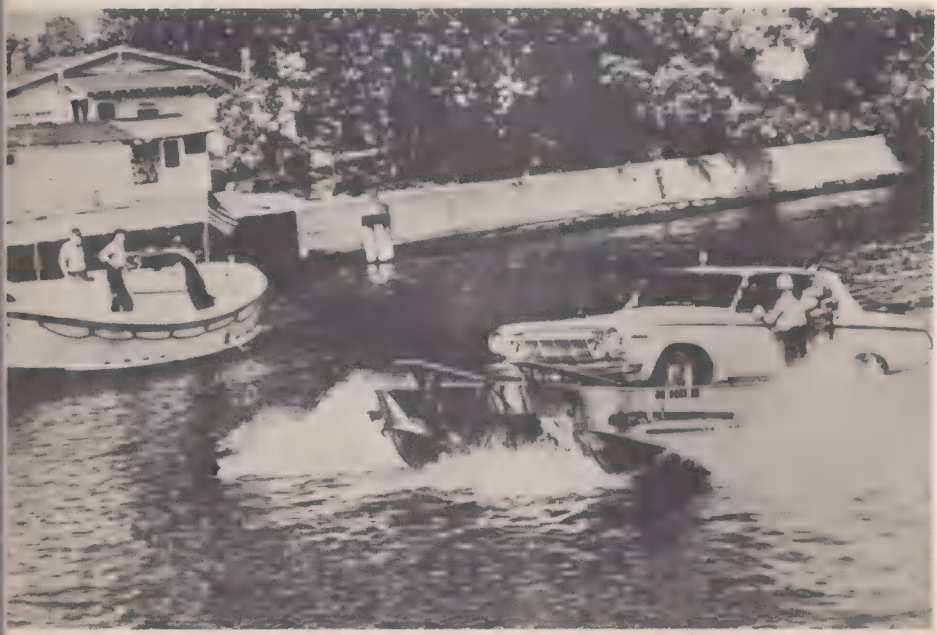
International Inventors' Show 1967

FROM September 9-17, New York's Coliseum will be a backdrop for the sometimes useful, often bizarre creations of inventors from 21 countries who are participating in the Third Annual International Inventors and New Products Exposition. On display will be their latest ideas and inventions—from a flying submarine to digestible safety pins. (See following pages for a brief preview of a few of the inventions.) Inventors will have an unparalleled chance to discuss ways of marketing their products with interested companies.

Solar Motor invented by Edward T. Hall (U.S.) converts light energy into rotational energy. The machine is designed to generate energy in response to direct sunlight or any other light source available. Instead of using conventional permanent or electric magnets, according to the patent application, the solar motor will run by using the earth's own magnetic field. Speed and direction of the rotation will be readily adjustable.



Did this car jump the road and land on a passing barge? No, indeed. The Autamaran, constructed of aluminum pontoons, is made to propel a car through water at 25 mph by using power from the car's own transmission. John Brush, inventor of 4800 lb. vehicle, worked out a system of universal joints that enables him to hook the car's engine to a propeller, then back his car onto pontoons and in 15 minutes to the amazement of onlookers, turn two machines into a seaworthy craft.



Women may soon find themselves at a fork in the fashion road with forks in their shoes. Using the spike heel popular a few years ago, inventor Edward Kittrich (U.S.) built a double-pronged heel to give wearer a better grip on bumpy ground. He doesn't say, though, what happens if prong gets caught in a sidewalk crack.

Has your child had his daily supply of diaper pins today? If not, feed him a few of Hiyachi Nakamura's vegetable base Safety-Baby Diaper pins, after you're finished using them on the diaper, of course. Made to dissolve in case baby swallows a pin, the Safety-Pin is completely digestible—it's vitamin enriched. From Japan.

An answer to nightmares of city traffic? Bill Alden's (U.S.) bi-modal StaRRcar may well be. The future urban commuter starts his rented electric-powered StaRRcar with license-registration card, drives along regular roads, enters covered track at station, hooking into line of StaRRcars sailing along bumper-to-bumper at a steady 60 mph. The driver pushes destination button and settles back with a newspaper until he arrives at his station stop.

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the **Science Digest** staff.

About simultaneous discovery

Why do two or more scientists who are unaware of one another's work often hit upon the same theory at the same time?

The simplest way of answering this is to say that scientists do not work in a vacuum. They are all embedded, so to speak, in the structure and developing progress of science, and are all faced with the same problems at the same time.

Thus, in the first half of the nineteenth century, the matter of evolution of species was very much "in the air". Some biologists were hotly against the very notion, while others speculated avidly on the consequences of such evolution and on finding evidence for it. The point is, though, that in one way or another, almost every biologist was thinking about the matter. The key problem was this:

If evolution takes place, what causes it to take place?

In Great Britain, Charles Darwin was thinking about this. In the East Indies, another Englishman, Alfred Wallace, was thinking about the same problem. Both had been world travelers; both had made similar observations; and both at a crucial point in their thinking happened to read a book by Thomas Malthus which described the effects of population pressure on human beings. Both Darwin and Wallace began to think about population pressure on all species. Which individuals would survive, which would not? Both came up with the theory of evolution by natural selection.

This is not at all surprising, really. Two men working on the same problem in the same way, faced with the same facts to observe, and with the same books written by others, might very likely come up with the same answers. What surprises me much more is

that Darwin, Wallace, and Malthus, all had the middle initial R.

In the latter part of the nineteenth century, many biologists were trying to work out the mechanics of genetics. Three men, all working on the same problem at the same time and in the same way, but in three different countries, came to the same conclusion. But then each one, looking back through the literature, discovered that someone else, Gregor Mendel, had worked out the laws of heredity thirty-four years earlier, and had been ignored.

One of the great challenges of the 1880's was the cheap production of aluminum. The nature and uses of the metal were known, but it was difficult to prepare it from its ores. Literally millions of dollars depended on the development of an easy technique. It's hard to say how many different chemists all worked on the same problem, with the same experiences of other chemists to draw upon. Two of them, Charles Hall in the United States and Paul Héroult in France, came up with the same answer in the same year, 1886. That's only natural, but how about this: Both had names beginning with H, both were born in 1863 and both died in 1914.

Right now, many people are trying to work out theories to explain the behavior of subatomic particles. Murray Gell-Man and Yuval Neweman, one in America and one in Israel, came up with similar theories simultaneously. The principle of the maser was worked out in the United States and the Soviet Union simultaneously. And I'm pretty sure the key process for the future use of practical fusion power will be answered independently by two or more people simultaneously.

Of course, sometimes lightning strikes once, only. Gregor Mendel had no competition; nor had Newton nor Einstein. Their greatest ideas occurred only to them, and the rest of the world followed.

—Isaac Asimov

Which is the longest snake in the world?

Most professional zoologists believe that the regal or reticulated python of the jungles of Southeast Asia, which often attains a length of over thirty feet is the longest, followed by its close relative the Indian Python, of which twenty-five-foot individuals have been found. A close third is the anaconda or water boa of South America. Of course, there have been many exaggerated stories attached to these snakes, particularly to the anaconda, where 50-to-80-foot specimens have been reported. Unfortunately, none of these gigantic snakes, either alive or as snake skins, have been brought in for measurement. Until this happens zoologists will continue to treat such stories with skepticism.

Which is the world's largest mountain?

The question can be tricky because it all depends on what you

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mean by "largest". Everest is of course the highest (rumors of an even higher mountain in a remote area of China have proved unfounded). But the "largest" mountain is Mauna Loa in Hawaii. Although its altitude is a mere 13,680 feet compared to 29,028 for Everest, the mass of the volcanic Mauna Loa makes up half the island of Hawaii. Mauna Loa rises more than 30,000 feet above its base. The total volume of this gigantic volcano is estimated to be 10,000 cubic miles.

What is a stonefish?

There are three species in the stonefish genus *Synaceja—horrida, trachynis* and *verrucosa*. They are ugly, lumpy fish that do look very much like stones when lying on the coral bottom in the shallows of tropical seas which are their favorite resting places.

The stonefish is as dangerous as it is ugly for it is equipped with two venom sacs in each of its long dorsal spines, and each spine is capable of piercing the foot of the unwary and paralyzing him with its agonizing sting. The fish is not aggressive but people are often stung by them while wading.

"The venom of the stonefish," writes Kelvin C. B. Green in *Sea Frontiers*," is capable of causing death. Collapse in less than six hours, on an average, was formerly often attributed to exhaustion and heart failure, but later discovery of cardiotoxins in the venom reveal this to be a mistaken diagnosis.

BOOKS

Out of the Shadows

Lost Land Emerging. Walter B. Emery. Scribners. ($7.95).

Nubia has a ghastly history. This famous but vaguely defined land is so hot and dry that man can barely exist there at all. Comfort and prosperity are completely unknown. Even the reasons for its fame are tragic, for it served as the principal ancient battleground between the Egyptians of the north who were trying to carve out a southern Empire, and the peoples of Central Africa who were trying to push their way up to the more fertile parts of the Nile valley and the Mediterranean coast. Despite its status as stepping stone for conquerors, Nubia did, during its infrequent periods of peace, develop a culture of its own, but one that has until recently remained almost unknown. Now Nubia itself is about to disappear, to be turned into a lake backed up behind the high dam at Aswan. The thought that important sites might be lost forever has infected archaeologists with a sense of urgency, even panic. This has occurred twice before: At the turn of the century when the Aswan dam was first built, a small portion of Nubia was flooded, and in the 1930's when the height of the dam was raised, flooding more land. Both times rush expeditions were launched to try to save as much as possible, and at least make a record

This bronze, human-headed hand lamp with eyes of garnets set in silver was one of the Nubian treasures Walter B. Emery rescued from tombs of mysterious X-people.

of what could not be saved. The present international effort is the largest of the three, in fact it is the largest archaeological project ever undertaken. Moving the temple of Abu Simbel has captured most of the headlines, but it is only a small part of the work being done in Nubia.

Of the many popular books that have been written on archaeology in Nubia in the last few years, the new one by Walter B. Emery is by far the best. Emery headed the second archaeological survey thirty years ago, and has been influential in planning and organizing the British contribution to the present international effort.

No one knows Nubian archaeology

as Emery does, and no one has been as devoted to it. Despite endless hours spent working in the 120-degree heat of the Nubian desert, Emery has developed a genuine love for this harsh and unlovable land, and the quality adds life to his writing.

Not only does this book give an excellent survey of Nubian history, but its author has some fine personal excavation stories to tell. Emery supervised the excavations of the macabre and treasure-filled tombs of the X-Group people at Bellana and Qustol. He also excavated Buhen, a gigantic fort in the desert which probably formed part of the greatest manmade barrier in the ancient world.

Lost Land Emerging is satisfying stuff for the archaeology buff.—*DC*

The Levittowners. Herbert J. Gans. Pantheon Books. ($7.95)

For those irritated by the novelist's picture of sea-slug social conformity, and five-and-dime culture in the suburbs—and dissatisfied with the clinical question-and-answer surveys of exurban life—Herbert Gans has written an account of the evolution of a surburban community that is modest about its goals and open-ended in its conclusions. No doubt the notion that "in order to know people one has to live with them" prompted Mr. Gans to buy a house in the third of three Levittown housing developments and live there for two years as an investigator-in-residence. His neighbors knew that he was doing research on the community, though not exactly for what purpose. Flattered at being chosen for study, according to Mr. Gans, most people spoke freely about themselves.

By his own definition, the writer's position is neither as an apologist for suburbia nor as a defender of sociological stererotypes. However, in delineating the policy struggles that ensued among community factions [about the structure of the school system, for instance] his tone is noticeably warmer toward the cosmopolitan liberal. This is understandable in view of the fact that Mr. Gans is a sociologist and consequently has a certain education. income, values and, of course, prejudices, associated with his profession.

He chose Levittown as an observation-post because it was a community planned *in toto*. All the arrangements of houses plus general layout of local institutions and facilities were built before people moved in. Inexpensive houses, easy payment plans and VA mortgages naturally attracted low and middle income people.

However, this community was not chosen, as Mr. Gans clearly states, as a prototype of American suburban life, but as a particular community with specific needs.

Underlying his three-part analysis is the thoughtful premise that there is an intrinsic lack of understanding by the professionals who plan, build and service a community of the people who live in it. As any sociological study of this kind

should, his book also pursues the question raised by many critics of suburban life: Is the community designed to accommodate the economic, social, educational and political needs of the inhabitants? Or are the lives of the people shaped by the nature of the suburban structure? And, who influences the decision-making process more—the people themselves or politicians and city planners motivated by economics and by their ideas of what people should have in the way of a community?

Mr. Gans' reporting is scrupulous, but his examination of personal social groupings is restricted by the proprieties of neighbor relationships. When invited to parties, men's social club gatherings, etc., he had to rely for information on what he could observe and the casual questions people asked each other. Because of the public nature of PTA meetings, religious and political organizations, his description of these groupings is more detailed and conclusions more shrewd.

A good bit of the material is repetitious, but that's as much due to the writer's having to assess social behavior patterns from different vantage points as his penchant for reviewing facts already discussed.

Anyone interested in the social make-up of this country should find this comprehensive, if prosaic book worth reading, at least until a much needed and equally comprehensive study of suburbia-at-large comes along—*AS*

Advertisement

Why Do You Read So Slowly?

A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to double your reading speed and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income by reading faster and more accurately.

According to this publisher, anyone, regardless of his present reading skill, can use this simple technique to improve his reading ability to a remarkable degree. Whether reading stories, books, technical matter, it becomes possible to read sentences at a glance and entire pages in seconds with this method.

To acquaint the readers of this publication with the easy-to-follow rules for developing rapid reading skill, the company has printed full details of its interesting self-training method in a new booklet, "How to Read Faster and Retain More" mailed free to anyone who requests it. No obligation. Send your name, address, and zip code to: Reading, 835 Diversey Parkway, Dept. 690-019, Chicago, Ill. 60614. A postcard will do.

QUIZ

Nuclear changes

by John and Molly Daugherty

SOME nuclear changes occur naturally. Man produces others by bombarding the nucleus of an atom with suitable atomic particles. In nuclear equations, the subscripts are the atomic numbers of the elements, and the superscripts are the total atomic mass units of the protons and neutrons. In simple nuclear changes, the subscripts must balance, and the superscripts, too, on both sides of the equation. What do you know about these nuclear changes?

1. In 1932, one basic particle in the atom appeared with this reaction:
   $_4Be^9 + {}_2He^4 \longrightarrow {}_6C^{12} + {}_7X^?$
   beryllium, helium nuclei, carbon
   The particle X is the
   a. Electron
   b. Proton
   c. Neutron
2. $_7N^{14} + {}_2He^4 \longrightarrow {}_1H^1 + {}_8O^{17}$
   nitrogen, helium nuclei, hydrogen, oxygen isotope
   This is a process of nuclear
   a. Fusion
   b. Transmutation
   c. Fission
3. The most useful radioisotope for biological research is
   a. C^{14} carbon
   b. O^{15} oxygen
   c. N^{13} nitrogen
4. The first isotope not occurring naturally on earth but produced by man was
   a. $_3Li^6$ lithium
   b. $_{15}P^{30}$ phosphorus
   c. $_{12}Mg^{28}$ magnesium
5. The element for which at least 20 artificially radioactive isotopes have been produced is
   a. Boron
   b. Germanium
   c. Cesium
6. Natural radioactive elements give off alpha and beta particles and gamma rays. Alpha's are helium nuclei, and beta particles are electrons.
   $_{90}Th^{230} \longrightarrow {}_7X^{226} + {}_2He^4$
   thorium, helium nuclei
   The subscript of element X is
   a. 88
   b. 89
   c. 90
7. When a radioactive element gives off a beta particle:
   $_{91}Pa^{234} \longrightarrow {}_7X^{234} + {}_{-1}e^0$
   protractinium, beta particle
   The subscript of element X is
   a. 90
   b. 91
   c. 92
8. A possible nuclear reaction is:
   $_{92}U^{235} + {}_0n^1 \rightarrow {}_{54}Xe^{140} + {}_{38}Sr^{94} + 2{}_0n^1 +$ rays + energy
   This nuclear process is
   a. Fusion
   b. Fission
   c. Transmutation
9. A *ghost* particle necessary to the scheme of things in atomic theory and finally identified is the
   a. Neutrino
   b. Positron
   c. Photon

Answers:

1—c Neutron. The subscripts balance on both sides of the equation so that the charge on X is zero. The superscript of X is 1. This particle is the neutron ($_0n^1$) discovered by Chadwick in 1932.

2—b Transmutation. The early alchemists dreamed of changing one element to another. Now such change

is a reality. Fission is the splitting of the atom into two elements having atomic masses about half that of the atom being split. Fusion occurs when four hydrogen atoms combine to produce one helium atom.

3—a C^{14} (carbon). This isotope of carbon has the unusually long half-life of 5770 years. In contrast, the isotope C^{11} has a half-life of only 20 minutes. The half-life of 0^{15} is just 2 minutes and that for N^{13} only 10 minutes—both too short a time for time-consuming experiments. C^{14} is being formed and broken down continuously in nature. Another use for this isotope is in the carbon-dating process for events occurring as long as 50,000 years ago.

4—b $_{15}P^{30}$ Natural phosphorus is entirely $_{15}P^{31}$. The preparation of the isotope $_{15}P^{30}$ was the first example of artificial radioactivity and also the first production of an isotope not occurring naturally in the earth. The nuclear equation is:

$$_{13}Al^{27} + {}_{2}He^{4} \longrightarrow {}_{15}P^{30} + {}_{0}n^{1}$$

aluminum nuclei helium nuclei phosphorus neutron

After the first achievement, more than 1,000 radioisotopes followed within about twenty years.

5—c Cesium. In the natural state, cesium occurs as cesium-130, and it has one stable isotope, cesium-133. The artificial isotopes have atomic mass numbers ranging from 123 to 148. All have the same number of protons (55), but they vary in the number of neutrons in the nucleus. As long as the number of positively charged protons remains the same, the atom is still the same element.

Advertisement

Russians Learn While Asleep

(WE KNEW IT ALL THE TIME)

News items appearing in newspapers and magazines throughout the nation report that: "In the Kiev State University, a woman student mastered a complete course in English in 28 nights."

"A philologist at the Ukrainian Academy of Science says that sleep-learning is less tiring to the brain than normal learning."

This "new" Russian discovery has been in use for over 2,000 years. In the United States sleep learning has been actively used since 1922 when Chief Radioman J. N. Phinney of the U.S. Navy successfully taught Continental Code during sleep. Since then, the use of sleep as a time for learning every kind of material, has become a reliable and accepted addition to our learning programs. The technique of sleep learning is being used by professionals, students and instructors, sales and corporate executives, housewives and mothers . . . along with many personalities in the public eye such as: Jan Sterling, José Ferrer, Red Buttons, Efrem Zimbalist, Jr., Sam Wanamaker . . . and many others — who use the time of sleep to absorb information effortlessly and painlessly for instant recall when awake.

To acquaint the readers of this newspaper with the simple techniques that allow constructive use of your sleeping hours, the Self-Development Research Foundation, a leading researcher in the field of learning while asleep, has published a compilation of Research Studies. These easy to understand reports tell you how to absorb any material while you sleep. Learn languages; learn to relax and control tensions; control your weight; sharpen your memory; develop your sales ability — all while you sleep, and without losing your rest.

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6—a 88. When the nucleus of the thorium atom emits an alpha particle, the atomic number is reduced by two protons, and a different element is formed. The element X is radium. Its atomic mass units equal 226, since the helium nuclei holds four mass units which come from two protons and two neutrons.

7—c 92. The electron comes from the breakdown of a neutron into an electron and a proton. The proton stays in the nucleus of the protractinium and increases the atomic number by one and produces an isotope of uranium. The electron is emitted as the beta particle with zero mass units.

8—b Fission. The end product elements produced in splitting the uranium atom lie near the middle of the periodic chart. Other pairs of elements such as barium and krypton or antimony and niobrium may occur. Under proper conditions the neutrons which are released may carry out a chain reaction.

9—a Neutrino. Early study of conservation of energy showed some discrepancies in the emission of beta particles. By 1931 Pauli suggested that an unknown particle must be carrying off some of the missing energy. Fermi named it neutrino. It was referred to as massless and uncharged, doing its work invisibly or in ghostlike fashion. In 1956 a particle, the antineutrino, was detected and with that the neutrino's existence was assured.

Score yourself:

8—9 right—Nuclear changes are clear to you!
4—7 right—Fusion is still a little confusing.
0—3 right—Better stick to chemical changes.

"I keep thinking of all those dogs up there howling at us."

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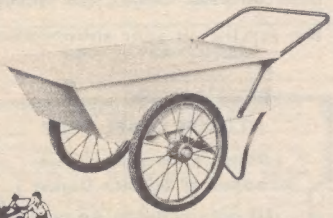

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LETTERS TO SCIENCE DIGEST

A what?

In "Modern Monsters" (May '67) the name of the Icelandic water monster is misspelt. It should be Skrimsl or Skrimsli, not "Skrismsl". There is a fjord in the northwest that bears the name Skrimslafjordur. The word Skrimsi is not confined to water inhabitants only, it is very similar to the English word "monster".

THORSTEINN GUDJONSSON
Reykjavik, Iceland

Hardiest congratulations

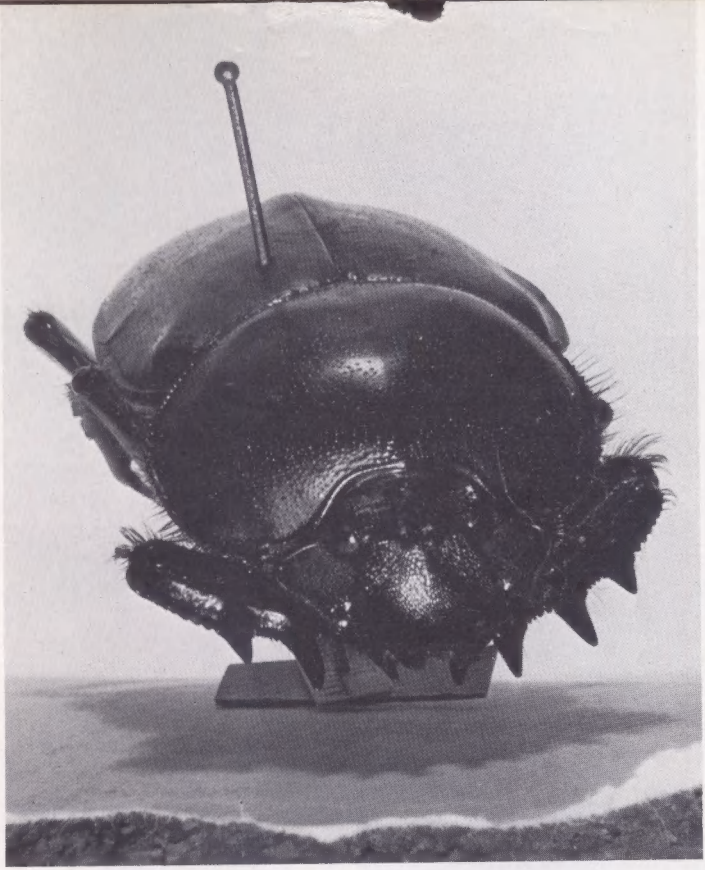
I would like to offer my hardiest congratulations to your editors, photographers, writers, artists and anybody else who contributed to the May and June 1967 issues of your magazine. These issues had some of the finest scientific articles I have ever seen in *Science Digest.*

R. HICKMAN
Mobile, Ala.

Dry valleys

In reference to the mystery of the dry valleys of Antarctica, (April '67) suggest that the answer to the riddle is in the story itself. The article states that the ground is very warm deeper down. This indicates a hot-spring, and brings to mind freeze drying, with heat below and cold above, complete dehydration will result. This would account for the mummified seals, and the absence of snow.

E. S. FORESTER
Burnbay, B.C. Canada



The beetle of life

PINNED to a wooden display block, this scarab beetle is pretty ugly, even for a beetle, but its looks didn't keep it from being a symbol of life after death in ancient Egypt. Ignorant of the beetle's true origins, the Egyptians thought it sprang full-grown from the sand. In their reverence for this spontaneous birthing, Egyptians had sculptors carve stone and clay models to be worn as amulets or enclosed in mummies' wrappings for burial in the tomb. If the Egyptains had known how it really came into the world, the sacred beetle probably wouldn't have been so sacred. Scarab beetles lay their eggs in balls of dung which are tucked into mounds of warm sand. The developing larvae eat their way out of the dung and when the food is finished, *voila!* a full-grown beetle of life has been "born." The ossified insect is now on exhibit at The Philadelphia Academy of Natural Sciences.

In this issue . . .

Today's generation of college students are the most affluent and freest ever. They are also the most troubled. A noted psychiatrist explains the paradox. P. 65.

A stainless steel ship hull that will last far longer than conventional hulls is just one of the innovations highlighted this month in New for Industry. Page 58.

A bronze human-headed hand lamp with garnet eyes set in silver was an outstanding find made by Walter B. Emery in mysterious treasure-filled tombs in Nubia. See Books, page 91.

Our fears, our phobias and our neuroses—are they products of the tensions of modern life or are they built in parts of human nature? A renowned scientist tackles the question. P. 38.

Who's the skier this girl is watching on TV? Why herself, of course. Seeing your own mistakes is a new teaching use for "instant replay". Page 18.

If the walking perch gets tired of the pond it is in, it just stands up on its gill covers and moves right off to a new one. Page 57.

The uninhibited drawings of children can be an accurate portrayal of a society. A report on a project to collect the art of Aborigine children begins p. 20.

Seeing double? No this twin heel is for real; a unique contribution to this year's inventors show. A photo story begins on page 85.